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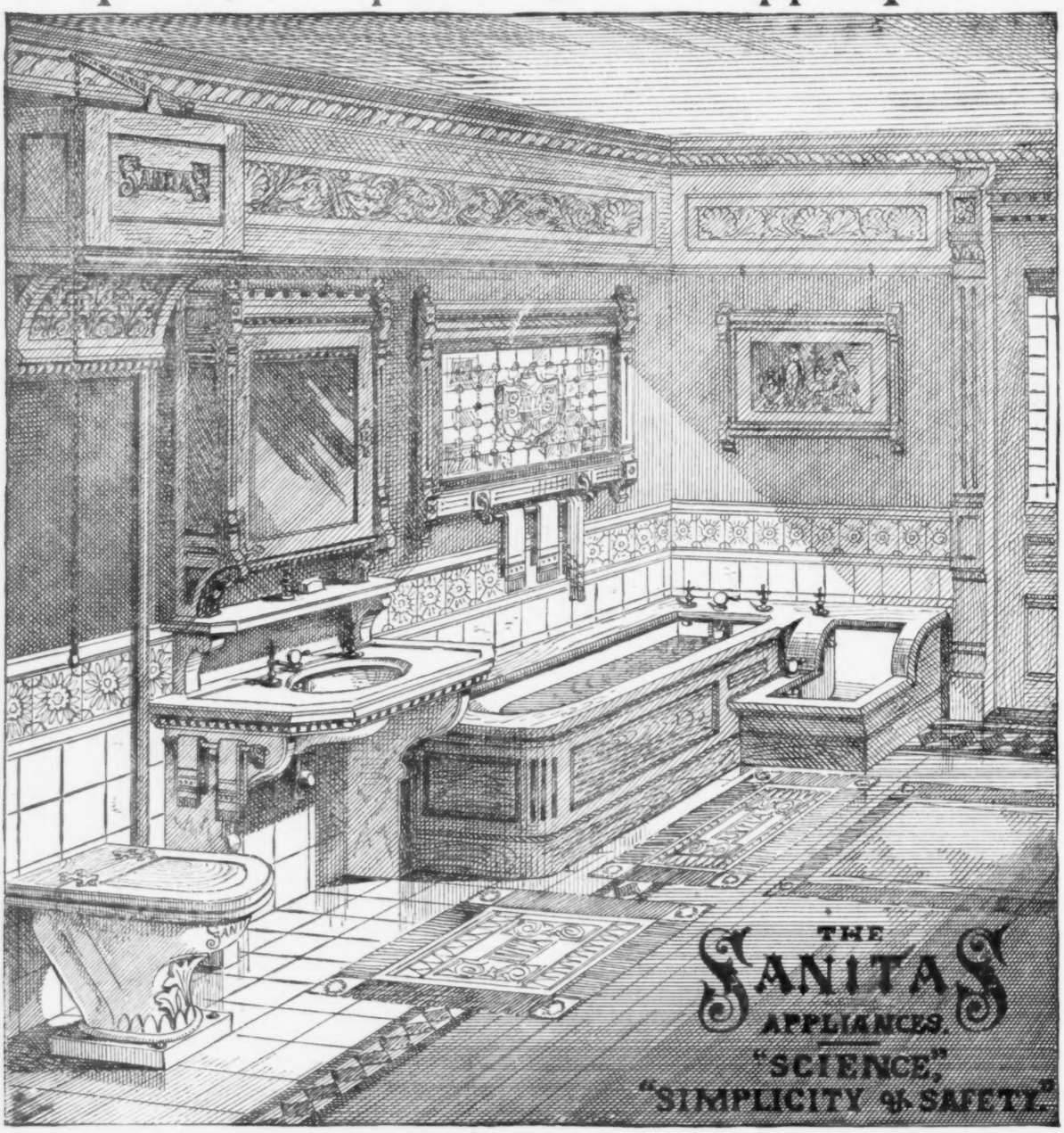
VIEW OF BATH-ROOM FITTED UP WITH THE

SANITAS PLUMBING APPLIANCES



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WITHIN a year or two it has occurred to some one to make excavations in the forbidding-looking desert on the top of the Athenian Acropolis, and many curious discoveries have been made. Judging from the character of the objects found, it is conjectured that after the first and most successful attack of the Persians upon Athens, during which they burned and overthrew nearly all the sacred buildings on the Acropolis, the Athenians, in their haste to rebuild them in more beautiful form than ever in commemoration of their final victory, must have used the debris and rubbish on the ground for filling hollows and levelling the rocky, broken site for the reception of the great works of Ictinus. Although the sacred statues were undoubtedly removed from the ruins and well cared for, the temples are known to have contained scores, or more probably thousands of votive offerings in the shape of images of greater or less size, which, being manufactured by wholesale, just as silver hearts and other objects are at the present day for devotees to hang up in the pilgrimage churches, had very little value in the eyes of the Athenian engineers, and were used, with other broken rubbish, as filling for the depressions of the ground. There they have remained undisturbed for twenty-three hundred years, and great quantities of them are now brought to light in the excavations. They appear to belong in general to the period from 525 to 500 B. C., and many of them are rather dolls than statuettes, the arms being often jointed, while the whole figure is almost invariably painted. According to Mr. Ernest A. Gardner, who is quoted in the *Builder*, the effect of the coloring is "pleasing." We must say that our own faith in the color-sense of the ancient Athenians has been a good deal shaken by experience, and, although Mr. Gardner's description of the painting of the figures is interesting, we reserve our enthusiasm as to the effect of the decoration. According to him, the color is "never applied in mass to a broad, flat surface, but a small, visible portion of an undergarment is usually colored, and the white marble of the draped portions is relieved with patterns and borders in dark green, dark purple, red or blue," after the manner, we suppose, of the plaster figures of Christ in the windows of dealers in Catholic ecclesiastical goods. Unlike these, however, which have the faces and hands painted pink, the "carnations," or nude portions of the Greek statues are left white, with the exception of the hair, which is always of a reddish brown, and the lips and the iris of the eyes, which are painted red. We must be forgiven for thinking that a white marble statue with auburn hair and red lips and eyes, although it may possess what Mr. Gardner calls a "richness and harmony of effect," must leave something to be desired in the way of expression, if not of coloring, and, although we are earnestly called upon to prefer this "entirely honest" style of representing nature to the despicable one of "hiding true surface" by painting it all over, we are still childish enough, if we are to have dolls at all, to prefer the naturalistic sort, whatever may be their want of sincerity, to figures with marble countenances and pink eyes.

IT is pleasant to find architects in England taking an important part in the promotion of general technical education. Not long ago a meeting was held in London, in the house of Mr. E. C. Robins, at which a large number of architects, besides the distinguished host, were present, with many other guests, while Professor Huxley, whose contempt for untechnical architects is well known, presided with a grace which seems to indicate that he retains a suitable respect for those members of the profession who like to understand thoroughly the art to which they devote their lives. The principal business of the meeting was to listen to an address by Professor Ayrton, on the Technical Training at the Central Institution, a school of applied science established at South Kensington by the Institute of the City and Guild of London, of which Mr. Robins is an active member. It is hardly necessary to say that Professor Ayrton's address was clever and suggestive, and his remarks on the importance of such training to architects were particularly just. Speaking of the matter of heating and ventilation in buildings, he said that he could not see why it should not be as easy to obtain and teach accurate practical rules about the flow of heat and air as about the course of electrical currents, yet, while electrical conductors by the mile are set up every day in the most complex relations without the suspicion that the current in any one of them would be found to flow in a different direction from that anticipated by the engineer, conducting pipes for warm and cold air are continually put up under the direction of architects, which act as inlets where they were designed to serve as outlets, or *vice versa*, or perhaps content themselves by producing total stagnation. "Hence," as he said, "the professional constructor of ventilating and warming appliances is certainly at present far behind the electrical engineer."

WE know well enough that many architects will say indignantly that they are "artists, not professional constructors of heating and warming appliances," and that they should not be blamed if the air in their ventilating shafts moves occasionally in the wrong direction; but, although this attitude is understood in the profession, it is every day becoming more and more incomprehensible to persons outside the profession. As Professor Ayrton went on to say, if the closeness or chilliness of certain public buildings comes from the imperfect technical knowledge of the architect who designed the heating or ventilating apparatus, it is for the interest of architects that they should get a better knowledge of the subject as soon as possible, and this is nearly the unanimous sentiment of persons outside the profession. The idea prevalent among the older architects, rather than the more modern generation, that the application of the Five Orders to building is an art so vast and noble that the mind which grasps it cannot contain anything else, finds no sympathy in the outside world, and the architect who does not know how to warm a house comfortably, or supply its rooms with pure air, is looked upon as only half instructed. Whether the technical knowledge which prepares a young architect to do this sort of work well helps or hinders him in designing pretty things we will not inquire, having no desire to enter into that perennial controversy; but as we have seen a great many beautiful buildings which were perfectly well ventilated, and a considerable number of ugly ones which were badly ventilated, we infer that the two kinds of skill are not totally incompatible; and in this case the architect who combines the two in the highest degree is pretty certain, in the present age of the world, to secure the most employment.

WE know of only two or three buildings specially constructed in this country for the use of architects in their professional work, and they seem to be equally rare abroad. The rule with us is for the architect to hire rooms in the busiest quarter of some city and carry on all his affairs there, leaving his office at night for his home, to which he is very apt to carry some work in the way of sketching or specification-writing

to occupy the evening, and the late Mr. Richardson was the only American architect in extensive practice, so far as we can remember, who carried on his business in his own house, adding, as occasion required, rooms for his assistants in a wing of the building. This way of conducting affairs, which has much to recommend it, independent of the consideration that the rent of a separate office is usually enough to pay the salaries of one or two good draughtsmen, is, we need hardly say, the usual method abroad, where the architect makes his drawings and receives his clients in his own house or apartment. Occasionally, where a man's business is too large to be accommodated in two or three rooms of a dwelling-house, a Paris or London architect will go to the expense of hiring offices near the centre of the town, but this is quite exceptional. In Berlin, where some of the best architects have now an immense connection, the noted firm of Kayser & Von Groszheim, after carrying on for many years a business which has brought it to the highest reputation in the attic rooms of the two adjoining dwelling-houses occupied by the members of the firm, has just erected in the neighborhood a building designed throughout for the accommodation of their professional work, which we find illustrated in the *Deutsche Bauzeitung*. Except the janitor's apartment of two rooms, the entire structure is occupied for drawing or business. The house, above the basement, is divided into seventeen rooms, three of which are occupied by the chief draughtsmen, while the others, with the exception of a small "conference-room" in each of three stories, and a large library in the first story, are devoted to drawing. In the story under the roof a large space is given up to the reproduction of drawings by photographic processes, for which a large dark chamber is provided, together with a work-room, and a "plateau" for exposing prints under cover.

A PICTURE-SALE took place not long ago in London, in which, although the collection consisted wholly of modern paintings brought together by a private gentleman of Glasgow, the average price realized for the pictures is said, by the *British Architect*, to have been about the highest on record. The owner, Mr. Graham, certainly deserves the credit of having bought with remarkable taste, and appears to have reaped the usual reward of discrimination in such matters. The place of honor at the sale was occupied by a picture by Gainsborough, two portraits of "The Sisters," which was bought by a dealer for fifty thousand dollars. Another picture, by Turner, a sea-piece, was purchased for thirty-four thousand by the same dealer, who bought another Turner picture, "An Italian Landscape," for nearly six thousand dollars. This dealer, Mr. Agnew, who purchased about one hundred and fifty thousand dollars' worth of the pictures, or nearly one-half in value of the whole collection, bid twelve thousand and seventy-five dollars for a picture by Sir Joshua Reynolds, which he had himself bought for thirty-one hundred and fifty dollars ten years ago, and had sold to Mr. Graham. It is hardly likely that Mr. Agnew would not know the market value of such articles, and we can only infer that a picture of the first class, bought as an investment, may increase four-fold in value in ten years. One of Sir Edwin Landseer's beautiful little pictures, two feet square, brought fifty-three hundred and fifty dollars, or nearly as much as a huge canvas by Millais, five and one-half by seven feet.

THE Government managers of the new city elevated railway in Berlin have, according to *La Semaine des Constructeurs*, taken a great deal of pains to diminish the noise of trains passing over the viaducts and bridges, which, of course, form the principal portion of the road. Wherever possible, the viaducts are built of brick or stone, and the sound of the light trains running over these is not very annoying; but arches of masonry cannot well be used in crossing crowded streets, and the metallic structures employed in such places rattle and reverberate in a manner which is considered very suitable to the nerves of the people of New York, but which the Germans are not disposed to endure. In experimenting to find means for overcoming the trouble, it is found that the form of the bridge does not perceptibly affect the noise from it, a lattice truss, notwithstanding the multiplicity of joints, producing no more sound than a plate girder, but the length is a very important factor, so much so that the noise is considered by the German engineers to be directly proportioned to the span of the bridge. Where the rails rest on wooden cross-ties, or on timbers running longitudinally, the sound is less than where they are secured directly to the metal, and it may be still further diminished by placing cushions of felt or rubber under the timbers before bolting them to the bridge construction. To cover an iron bridge entirely with planking does not appreciably diminish the noise from it unless the planking is covered with gravel, a thin layer of which has a marked deadening effect, while still more improvement is obtained by thickening the layer of gravel about the track so as to bury the cross-ties or longitudinal timbers on which the rails rest. Profiting by these suggestions, the Berlin engineers have adopted two different systems for diminishing the noise of trains on their viaducts. One is to bolt to the bridge-structure long troughs of sheet-iron, about sixteen inches wide, so arranged that a rail will come in the centre of each. The troughs are then filled with gravel, in the middle of which is buried the longitudinal timber carrying the rail, and the space between the troughs is covered with iron plates on which is spread a thin layer of gravel. The second method, which is found to be more efficient than the other, consists in placing a continuous series of shallow iron troughs, about five feet square, along the line of the tracks. These are filled with gravel, on which the ties and rails are laid.

DR. HECTOR GEORGE, who has a faculty of collecting interesting observations on physiological subjects, writes an article in *Le Génie Civil* on venomous animals, much of which is useful, as well as curious. As every one knows, the most dangerous creature of this sort in Europe is the viper, a small snake, which is found in all parts of England and the Continent, and, although less venomous than our common rattlesnake, is an animal to be carefully avoided. According to Dr. Viand-Grandmarais, who studied the effects of viper-bites in Brittany, and collected statistics of three hundred and sixty-two cases, sixty-three of those bitten, or nearly one-sixth, died from the effect. The character of the viper-poison seems to be nearly the same as that of the rattlesnake. The person bitten feels little pain, but after a time becomes faint, and often loses consciousness entirely. Then distress comes on, with cold sweats and nausea, the action of the heart grows feeble and slow, sometimes falling to twenty-eight pulsations a minute, and the patient dies, unless the constitution is strong enough to resist the effect of the poison, until it begins to abate. The remedies are also the same as those for rattlesnake bites; sucking the venom from the wound, which is the most effectual portion of the treatment if quickly employed, and large doses of strong, hot whiskey or brandy. The alcohol is said to act both as an antidote to the venom, and also, particularly if the liquor is taken hot, by its effect in producing a copious perspiration, which seems to aid in eliminating the poison, and, apparently for the same reason, ammonia, which, when taken internally, causes perspiration, has been found beneficial. Singularly enough, the Italian peasants long ago discovered that the poison of the enormous spider of Tarentum, may be eliminated through the skin, and when one of them is bitten by a tarantula, his first thought is to work himself into a profuse perspiration by the mad dance which has been the subject of so many romances, and has inspired so much music. Next to the vipers, the bees and wasps, small and unromantic as they are, seem to be the most efficiently armed of European animals, and many children, and even strong men, have fallen victims to their attacks. As a rule, the stings of these insects are fatal only when many are inflicted at once, but a single one occasionally causes death. The sting of a bee on the temple has been known to kill a man in ten minutes, and a child of six years, stung in the same place, died in half an hour; while men, stung on the eyelids, or in the nose, have died in a few minutes. The most vulnerable spot is, however, the neck, and the sting of a bee or wasp in that place often causes death by suffocation, through the swelling of the tissues, and the consequent closing of the wind-pipe, in a few seconds. Where a large number of the insects attack a person, death is not unfrequently caused by the mere pain, which causes a fatal shock to the nervous system. During the French and Prussian war, at the battle of Beaumont, a bee-hive within the German lines was overturned by a shell, or some other projectile. The bees rushed out and fell upon the soldiers near by with such fury as to kill four of them on the spot, while four more died soon afterward from the effect of the stings, and several others were rendered helpless for months.

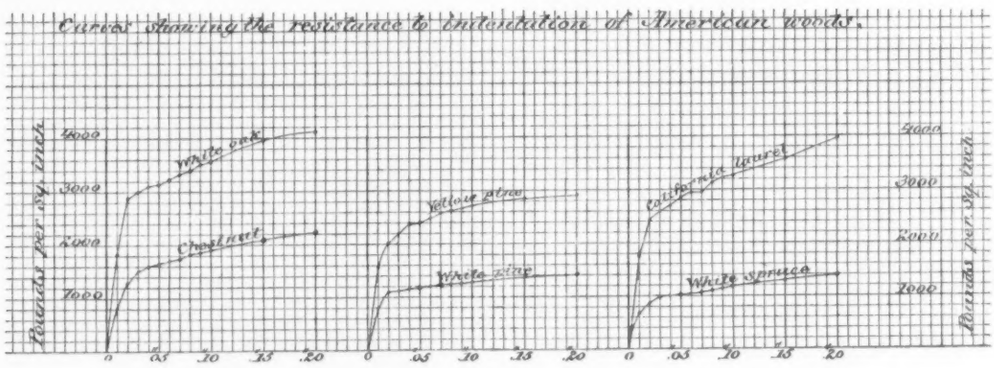
ADHESION OF NAILS, SPIKES AND SCREWS IN WOOD.

Magnified sectional view of the head of a wood-screw, showing the distortion of the fibres of the iron occasioned by upsetting during manufacture.

FUNDAMENTAL in the adhesive resistance of nails and screws is the friction between the surfaces of the metal and the wood which are in contact, in addition to which, at times, the shearing and transverse strength of the wood influences the results, also the strength and stiffness of the nails.

Taking the most simple case at first, in which a nail is driven into the wood by carefully-directed hammer-blows and then pulled out in the direction of its length, friction alone causes the adhesive resistance. In driving the nail, the fibres of the wood are both displaced and compressed, and in their efforts to recover from the compression, there is exerted a pressure against the sides of the nail, the amount of which depends upon the extent to which the fibres have been compressed and upon the quality of the wood. As will be shown, however, it does not follow that twice the compression of the fibres will cause twice the pressure against the nail, within practical limits the pressure not increasing in the same ratio that the wood is compressed.

This will be made clear by referring to another kind of tests which will be briefly considered before entering upon the discussion of the behavior of the nails themselves in the wood; namely, indentation tests. They consist in subjecting a part of the surface of a stick of timber to compression-loads acting on a flat-faced plunger, and ascertaining the loads required to indent the wood different depths. The accompanying diagram, plotted from the results of some indentation tests made at the Watertown Arsenal — see Report of 1883, which contains a very exhaustive series of experiments upon the strength of North American woods — illustrates the behavior of several kinds of wood tested in the manner above described. These curves fairly represent their respective species, although there is a wide range in the strength of the wood from different trees, and even in different parts of the same stick. Consequently, it is difficult to correctly estimate the strength of timber within narrow limits, although the observance of certain characteristics of good timber will aid very much in this direction.



The fact that hard woods require more pressure to indent them than soft woods requires no comment; it will be observed, however, that in the diagram both woods give a very steep curve at the start, the resistance increasing rapidly till the indentation reaches two to three-hundredths of an inch, after which the top of the curves become somewhat flat, indicating a considerable yielding of the wood without much increase of pressure. These tests are very useful, in showing the possibilities and the limitations which are reached in the direction of maximum compression of fibres. The problem is complicated by other considerations; as, for instance, when the wood has been compressed a certain amount it begins to split and relieves the pressure; furthermore, some destruction of the fibres will attend the driving of the nail, and it becomes a difficult question to decide just how much can be permitted in order to obtain the best results. The highest resistance will, of course, be reached when the fibres are compressed with the maximum pressure and their condition is such as to give the highest coefficient of friction between the surfaces of the nail and the wood, but it may be impracticable to arrive at the maximum values of these two conditions at the same time.

Wood tested in other directions, such as compression and transverse tests, show that a gradual yielding takes place under the action of a constant load much below that required to produce immediate rupture. Such action as this would cause a reduction in adhesive resistance after a nail had been driven some time, and, if the common impression is correct that old nails hold better than newly-driven ones, it must be due to an increase in the coefficient of friction from rust or other causes and not to an increase of pressure; that is, in case the wood was well seasoned at the start.

The compression from the tapering form of a nail extends in its effects a considerable distance into the wood, hence, to secure good results, it should not be driven close to the edge of the stick or in the vicinity of checks, as in either case there would not be sufficient supporting material.

The efficiency of sidewise compression of the fibres seems to be greater than endwise compression; that is to say, when a nail is driven perpendicular to the grain of the wood, the adhesive resistance is greater for the two faces which are parallel with than for those two faces which are at right angles to the grain. This is shown by driving a nail having the taper parallel with the grain, as nails are commonly driven, and driving another having the taper at right angles to the grain; the second nail will have the higher adhesive resistance; that is, when the taper acts against the fibres sidewise. The continuity of the endwise fibres are broken while the sidewise fibres remain intact, and, when strained by the nail there is advantage gained from the tensile stress which is brought into action as well as the direct compression.

Up to this time we have been considering the behavior of nails which were driven perpendicular to the grain, and have observed that compression of the fibres laterally, as represented by indentation tests, and compression endwise the grain, are elements of strength; also, that tensile stresses are brought into action in two directions; that is, parallel with the fibres and perpendicular to them, which is the stress that resists splitting along the grain.

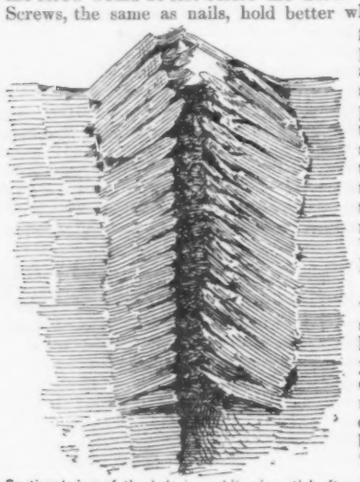
Inasmuch as the strength of wood in these several directions extends over a great range — or from 1,000 pounds per square inch, which produces a decided indentation of soft wood, up to 28,460 pounds per square inch, the tensile strength parallel to the fibres, which has been observed in a specimen of California laurel — it is obviously necessary to employ the wood in its strongest directions to obtain the best results. When nails are driven parallel to the grain — endwise the wood — there seems to be no option in the matter, placing the taper perpendicular or parallel to the rings of yearly growth, ordinarily producing too slight a difference to be certain of its identification. Exceptional cases would be found in woods which vary considerably in density at different parts of the yearly rings, and if very small nails were driven wholly in either the greater or the less dense sections. Nails parallel to the grain have adhesion due only to the indenting strength and tensile strength of the wood perpendicular to the grain, directions, as we have seen, of inferior strength. If the wood splits, it has only to split in one direction longitudinally from the nail, and the most ordinary observation teaches that woods split most readily when started at the end of the fibres.

These reasons are thought sufficient to explain why nails exhibit less adhesion when driven parallel instead of perpendicular to the grain, as there seems no occasion for believing the coefficient of friction differs materially in the two cases.

The resistance of screws in wood is not properly an adhesive resistance although, commonly referred to as such, the shearing, transverse and tensile strength of the timber are the principal resistances called into use.

In soft woods gimlet-pointed screws are usually required to form their own holes and when so doing compress the wood as well as cut a thread in it; it is doubtful, however, whether much useful effect results from this compression. Screws perpendicular to the grain frequently show the maximum resistance after they have been drawn several hundredths or even an eighth of an inch, differing in this

respect from nails which lose a large per cent of their resistance once they are started, it therefore seems that the effect of compression on the screw would be lost before the fibres were so much disturbed. Screws, the same as nails, hold better when perpendicular to the grain. When they are parallel to the grain it is almost a simple case of shearing the fibres, but if perpendicular to the grain the transverse and tensile strength of the wood have to be overcome. Such is the general statement of the subject: some data will now be presented from the Watertown Arsenal tests, Report of 1884.



Sectional view of the hole in a white-pine stick after drawing out a lag-screw, showing the injured fibres.

The tests were made with cut nails, wire nails, spikes, common screws and lag-screws in white pine, yellow pine, chestnut, white oak and laurel wood. The nails and screws were tested singly, also cleats held by two and four nails. The wood was seasoned with the exception of the chestnut which was unseasoned, and certain of the pine and oak sticks were water-soaked after the nails were driven. Unless otherwise started the cut nails and spikes were driven with the taper of their sides or points acting lengthwise the grain of the wood. Holes were bored for all screws equal to their diameter at the root of the thread or slightly smaller, except that wood-screws in soft wood formed their own holes. Few sticks were experimented upon, one object of the tests being to ascertain the comparative resistance of different sized nails and screws in the same sticks. The adhesive resistances are reduced by computation to pounds per square inch of surface in the wood, no account being taken of the surface of the points of the screws nor the tapering surfaces at the points of the spikes.

In the Government report are summarized the general averages of the results with each kind of nail and wood, as follows: —

TABLE I.

Kind of Wood.	Specific gravity.	Kind of Nail, Spike or Screw.	Average adhesive resistance per sq. in. of surface in wood. Driven perpendicular to the grain.	Driven parallel to the grain.
			Pounds.	Pounds.
White pine, stick A	.4666	Cut nails,	451	
White pine, stick B	.4717	"	350	208
" "		" corners barbed,	370	166
" "		" taper crosswise the grain	460	
" "		Steel-wire nails,	167	126
" "		Common spikes, ½″ sq.,	224	70
" "		Railroad spikes, .59″ "	262	
" "		Wood-screws,	925	654
" "		⅜″ lag-screws,	970	
" "		½″ " 5 threads per in.,	880	
" "		½″ " 6 " "	857	
White pine, stick C	.3922	1″ " 4 " "	551	
Yellow pine, stick D	.7862	Cut nails,	661	530
" "		" corners barbed,	473	397
" "		" taper crosswise the grain	768	
" "		Steel-wire nails,	318	252
" "		Common spikes, ½″ sq.,	432	
" "		Wood-screws,	1,493	1,213
" "		1″ lag-screws,	933	
Yellow pine, stick E	.6428	Common spikes, ½″ sq.,	629	
" "		1″ lag-screws,	991	
White oak, stick F	.7603	Cut nails,	1,195	1,070
" "		" corners barbed,	846	766
" "		" taper crosswise the grain	1,158	
" "		Steel-wire nails,	940	802
" "		Common spikes, ½″ sq.	764	
" "		1″ lag-screws,	1,171	
White oak, plank G	.8240	Wood-screws,	2,598	
Chestnut		Cut nails,	683	
"		" corners barbed,	618	
"		" taper crosswise the grain	735	
"		Common spikes, ½″ sq.,	720	
California laurel	.7190	Cut nails,	1,179	651
"		Steel-wire nails,	911	548
"		Wood-screws,	2,338	

From the data in Table 1 the actual resistance for a given case may be readily ascertained by first finding the surface in the wood and multiplying by the proper coefficient.

In Table 2 are given the actual resistances of several sizes of nails and screws taken from the details of the experiments. These figures would be found upon comparison to differ somewhat from those which might be deduced from Table 1, on account of the former table including a larger number of tests.

The results stated in Table 1, afford the means of ready comparison of the adhesive resistance of different nails and screws in the kinds of wood here represented.

TABLE II.

Kind of Wood.	Kind of Nail, Spike or Screw.	Size.	Length driven.	Total adhesive resistance. Driven perpendicular to the grain.	Driven parallel to the grain.
			In.	lbs.	lbs.
White pine, stick B	Cut nails,	50d	3.00	915	506
" "	"	50d	4.00	1,305	693
" "	"	60d	3.00	976	458
" "	"	60d	4.00	1,292	842
" "	" corners barbed,	60d	4.00	1,456	631
" "	" taper crosswise the grain	60d	4.00	1,749	
" "	3″ steel-wire nails,	″.148	2.00	139	105
" "	Common spikes,	″.50	4.00	1,456	453
" "	2″ wood-screws,	12	1.25	776	496
" "	" "	14	1.25	799	421
" "	" "	16	1.25	877	553
" "	" "	18	1.25	930	797
" "	3″ "	18	1.85	1,410	1,079
" "	3½″ "	18	2.10	1,703	1,294
" "	½″ lag-screws,		5.00	6,155	
White pine, stick C	1″ "		5.00	7,777	
Yellow pine, stick D	Cut nails,	8d	1.50	490	414
" "	"	20d	2.50	1,016	943
" "	"	50d	3.00	1,574	1,301
" "	"	60d	4.00	2,508	1,812
" "	" taper crosswise the grain	60d	4.00	2,918	
" "	" corners barbed,	60d	4.00	1,796	1,507
" "	3″ steel-wire nails,	″.148	2.00	264	209
" "	Common spikes,	″.50	4.00	2,806	
" "	2″ wood-screws,	12	1.25	1,322	1,037
" "	" "	14	1.25	1,364	929
" "	" "	16	1.25	1,495	1,235
" "	" "	18	1.25	1,635	1,395
" "	3″ "	18	1.85	2,308	
" "	3½″ "	18	2.10	2,488	1,951
" "	½″ lag-screws,		5.00	12,777	
Yellow pine, stick E	" "		6.50	19,955	
" "	" lag-screws,[1]		8.00	17,990	
White oak, stick F	Cut nails,	8d	1.50	945	780
" "	"	20d	2.50	2,003	1,731
" "	"	50d	3.00	2,976	2,462
" "	"	60d	3.00	2,843	2,848
" "	" corners barbed,	60d	3.00	2,361	2,138
" "	" taper crosswise the grain	60d	3.00	3,230	
" "	3″ steel-wire nails,	″.148	2.00	780	666
" "	Common spikes,	″.50	4.00	4,967	
" "	1″ lag-screws,		5.00	17,717	
White oak, stick G	2″ wood-screws,[2]	12	1.25	1,963	
" "	" "	14	1.25	2,478	
" "	" "	16	1.25	2,439	
" "	" "	18	1.25	2,645	

[1] Length of thread, 6.50 inches. [2] Fractured screws at the root of threads.

The sides of the cut nails were tapered about five hundredths of an inch per inch of length, and as the distance they were driven in the wood ranged from one and one-half to four inches it will be seen that the wood was compressed by the sides of the nails, after the points had entered, from .075″ to .20″, which upon reference to the diagram of indentation tests corresponds to those parts of the curves in which there was considerable indentation without rapid increase of resistance. From this and other reasons mentioned in the general discussion of the behavior of the wood we probably have the explanation why different sized cut nails driven to different depths gave results nearly alike, or within the limits of variation expected of several nails of the same size in the same stick.

In white pine stick B the cut nails, driven perpendicular to the grain, taken in the order of their resistance from lowest to highest, are first those driven in the ordinary way with the taper acting lengthwise the grain, next those with barbed corners and then those driven with the taper crosswise the grain. Except in the white oak, nails with the taper crosswise the grain gave the highest results of their class. In the soft pine, barbing seems to be advantageous, in the chestnut the reverse is the case, and in the yellow pine and white oak barbing is decidedly disadvantageous. The results might and probably would be quite different were it not for the fact that the barbed nail cuts and destroys the fibres on its downward course, while being driven, and this action is relatively more serious in the hard than in the soft woods. If barbed nails could be got into the wood, as screws are driven, without such destruction to the fibres in that immediate vicinity higher results might be looked for, but as the case stands the objections to barbed nails in certain woods seem to be insuperable.

Magnified sectional view of the head of a cut nail showing the distortion of the fibres of the iron occasioned by upsetting during manufacture.

The steel-wire nails gave results below the cut nails; in fact, they displayed the least adhesive resistance of any of the material tested, with the single exception of the common spikes driven in white pine

parallel with the grain, which last tests are themselves exceptionally low, as will be seen when referring to the relative resistance of nails driven perpendicular to and parallel with the grain. Whereas with barbed nails we have extreme roughness and irregularity of surface; with steel-wire nails the opposite extreme is met, the surface of the nail being very smooth; furthermore, the best results are attained when the fibres are gradually compressed as done by tapering forms and not when the total amount of wood is abruptly displaced as done by the points of wire nails and spikes.

The flat point of a cut-nail would seem to be more injurious to the wood than the point of a wire nail, and such is doubtless the case, but the important difference consists in the after compression of the wood, on account of the tapering form of the cut nail, the stem of the wire nail being of uniform diameter throughout. The same criticism applies to spikes with parallel sides with this further disadvantage, that they displace an excessive amount of wood and thus weaken the adjacent fibres. When large spikes are used a hole bored, under size to receive them, would materially assist and relieve a part of the above objectionable feature.

The highest resistances are displayed by the screws, the average results obtained with wood-screws in the white-oak plank G reaching 2,598 pounds per square inch. When so high a resistance as this is reached, it is readily understood that danger arises of pulling the screw apart by exceeding the tensile strength of the wire.

Such instances were met both with nails and screws in the hard woods. The resistance of lag-screws compares favorably with that of the wood-screws. The coarse pitch of the thread of the lag-screws may possibly account for the slight difference between the two kind of screws which is observed. Too fine a pitch of thread would not give the screws sufficient hold in the wood, while a very coarse pitch concentrates the compressive stress between the threads and the fibres on a smaller surface, and encourages crushing of the wood in detail in front of the thread.

The difference in resistance of the nails and screws in the two directions, perpendicular to and parallel with the grain, is conspicuous. The average results show the strength in the latter direction to be seventy per cent of the former.

In white oak the percentage rose to ninety, while common spikes in white pine gave the exceptionally low result of thirty-one per cent. If these spikes were not included, the general average would rise to seventy-four per cent, which is probably a more reliable figure.

Heretofore we have discussed average results, the mean of several experiments of the same size nail in the same stick is the recorded value for that item. These experiments, however, form no exception to the rule that more or less variation in strength may always be expected in timber tests. Thus, it has been found that in the compression tests of some small sticks eccentricity of loading, even to the concentration of the entire load on one edge of the specimen, failed to give direction to the deflection of the stick preceding the maximum load of rupture. In the present tests wide differences have been observed while experimenting upon the same stick. No reference is now intended to nails improperly driven with oblique hammer blows, or where the nail was close by a star-check or other seasoning crack, but to cases where the wood was apparently sound throughout.

In yellow pine, stick D, the nails which were driven in rows across the stick showed a decidedly greater resistance along one edge over the other, a difference which was also observed in the driving, and those which drove the hardest gave the highest adhesive resistance.

In driving nails oblique to the direction in which they will be pulled, some discretion has to be exercised. The experiments with single obliquely driven nails was not favorable to this manner of driving, the nails bent while they were being pulled, tore up the wood, and the friction against one face of the nail, the surface on the outside of the bend, must have been almost entirely released. Better results were obtained with oblique nails when used in cleats; here they showed greater resistance than nails perpendicular to the surface of the cleat, although in each case the resistance was below corresponding results with single nails.

Thus cleats nailed to white pine, stick B, gave resistances of 238 and 287 pounds per square inch, when the nails were driven perpendicular and oblique twenty degrees respectively. Cl ats on yellow pine, stick D, gave resistances of 436 and 499 pounds per square inch under the same conditions. The taper of the nails, 60d's were used driven 3″, was crosswise the grain of the sticks.

Some nails and spikes were driven in dry wood, and then the pieces exposed alternately to the tide-water and air, and thus intermittingly wet for a period of thirteen days, after which they were tested. The nails were not rusty when withdrawn, although the wood was apparently water-soaked as deep as the nails were driven. 60d nails were used, and spikes which were ½″ square by 8″ long, each were driven 4″ into the wood.

In white pine, stick B, the nails showed 199 pounds per square inch, the spikes 231 pounds per square inch resistance. In yellow pine, stick D, the nails gave 488 pounds per square inch, the spikes 296 pounds per square inch resistance. In white oak, stick F, the nails gave 786 pounds per square inch, the spikes 458 pounds per square inch resistance.

It will be seen that all of these results, with wet sticks, are below the corresponding resistances with dry wood.

A number of experiments were made on the resistance of driving 60d nails perpendicular to the grain. These tests were made by slowly driving the nails with hydraulic power, and noting the force required.

The maximum resistance to driving in white pine, stick B, was 391 pounds per square inch when the nails were driven 3″, and 397 pounds per square inch when they were driven 4″. In yellow pine, stick D, the resistances were 572 pounds per square inch, and 635 pounds per square inch for 3″ and 4″ depth of nail.

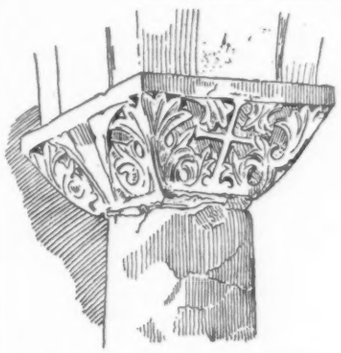
It was observed that the resistance to penetration was not uniform, but varied as different layers of the wood were reached; at times the nails would continue to penetrate the wood under a less load than had previously been resisted, this variation being from five to ten per cent of the load. These experiments were few, and as there were no observations on pulling the same nails a comparision of the resistances in the two directions cannot well be made, it is obvious, however, that the resistance to driving must be exceptionally low in the yellow pine.

The resistance to driving probably does not differ very much from the resistance to pulling, except so far as belongs to the displacement of fibres by the point of the nail which is encountered in the one case, but not the other, and the proportion which that resistance would bear to the whole should diminish as the nail is driven and the frictional surface in the wood increases.

The yielding of the fibres under high compressive loads has been referred to, and that behavior would cause somewhat greater resistance to driving than to pulling, provided some time elapsed between the two operations.

J. E. HOWARD.

LANDSCAPE GARDENING. — I.



CAPITAL, ST. ZENO, VERONA

After Drawing by R. Barrait in The Architect

SEVENTEEN years ago, Mr. Frank J. Scott, — a pupil of our first American landscape gardener, Downing — published a volume called "*The Art of Beautifying Suburban Home Grounds.*" It was issued with the wish, not to instruct men of his own profession, but to aid amateurs, by verbal counsels and clear illustrations, to do their own work more sensibly and artistically than had previously been the rule. Yet, a professional man himself, Mr. Scott was far from thinking that amateur work was in itself desirable. He loses no possible chance of impressing upon his readers the fact that work with nature's materials, when it passes beyond the effort to grow and care for plants, and concerns itself with their arrangement out of doors, is artistic work, and, as such, can be thoroughly well managed by a well-trained artist only. And this fact he insists upon as almost equally true whether the laying out of large public parks or of small private grounds is in question. In either case, as he explains, what we should try is not merely to have pleasing things in view, but to combine them into a picture — pretty if the space be small, beautiful or majestic if its size be great. And to make a picture, great or small, pretty or imposing, needs the touch of an artist's hand. But he thought himself justified — and certainly was justified — in writing a book to aid the amateur. "It would be as absurd," he explains, "for the mass of men, engrossed in active business, to devote a large amount of time to the study of the mere rudiments of gardenesque art simply to enable them to lay out a half acre or acre of land, as for the business man to pore over an architect's library and pictures to enable him to design his own house — provided skilful planters were as easily found a competent architects. Twenty years ago there was the same dearth of architects of culture as there now is of educated gardeners. The general study of domestic architecture, which Downing's works then aided to make a fashion, produced, at first, an astonishing fermentation and rising of architectural crudities, but it also produced, afterwards, a crop of architects. If we can induce every family who has a home to adorn to study the art of planning and arranging their own grounds, the seed will be planted that will germinate, in another generation, in a crop of art-gardeners of such high culture and of such necessity to the educated community that it will be one of the honored professions of our best collegiates. Now, however, the number of such men, devoted to this profession, is so small that we have not heard even of more than half a dozen skilled professional gardeners among our thirty millions of native Americans, and of not greatly more than double that number of educated foreigners who have established a deserved fame among us as men of culture in their art. Even these men, with few exceptions, are little known outside the wealthy circles of the great cities, and not half appreciated where they are known. Until employers are themselves persons of culture, artists,

even when employed, are regarded as a kind of dilettanti whom it is necessary to employ rather to conform to the 'fashion' than for such service as the employer is competent to appreciate and really enjoy the results of. We know of nothing that will at the same time cultivate a taste for the fascinating art of gardenesque designing, and produce a quick return of pleasure for the time spent, as the study of paper plans for one's own grounds."

No words could be more sensible. Intelligent amateur work is certainly better than unintelligent, and the more intelligent the amateur worker becomes, the more certain he is to realize that only the artist can truly succeed in art, and the more able to appreciate true success when it is achieved. My main reason, however, for citing Mr. Scott's book and quoting his words is in order that we may consider a little the standing and prospects of the landscape artist at this present moment.

The advance made since the year when his book was published — 1870 — has not been remarkably great, either as regards the number of our artists or the public's appreciation of their services. Yet some advance in the latter direction has certainly taken place. An editorial article in the *Century Magazine* for June, 1887, calls attention to the fact and points to this profession as one in which there is certain soon to be a greater demand than supply unless a larger number of young men seriously train themselves for its practice than heretofore. And we shall be convinced that this is true if we look about us in our own home neighborhoods, if we talk with architects about their own and their clients' wishes, if we ask our leading landscape-gardeners whether or no the calls upon them have recently increased, and if we notice the newspaper reports of the manner in which large public undertakings are now being approached, even when works of architectural and not of gardening art are the main concern. The public seems to be awakening to the fact that gardening is an art and an important one, that, therefore, artists are needed, and that they should be so thoroughly trained and so well endowed as really to deserve the name. These are interesting facts, and I think they merit a little consideration in these columns, for no one can do more than the established architect to help on the progress of this nascent reform, and there is no place where recruits for the landscape-gardener's profession may more naturally be looked for than in the ranks of those who are thinking whether or no they will devote themselves to the sister profession of architecture. I need not insist upon the fact stated in the *Century* editorial that the architectural profession is becoming overcrowded. Surely the intrinsic attractions of the other are sufficient to draw men towards it if it offers them any fair chance of a successful and honored career.

To begin with, there is no profession whatsoever — unless it be that landscape-painter's — which suggests to the imagination so delightful an existence. It offers the chance of a life spent largely out of doors, in which the love of nature may be indulged, not as a casual refreshment, but as the very basis and inspiration of one's day's work. It involves the need for frequent travel and promises that broadening of mind which change of scene and contact with new groups of men supply. An art in itself, it works hand in hand with the art of architecture, and the landscape-gardener cannot but share the pride of the architect himself when the one has beautifully set and shown what the other has beautifully built. Broad as is the mental field which the architect may compass, the landscape-artist's is still broader, touching the domain of science on the one hand and that of idyllic poetry on the other. And so truly is his craft an art that there is no artistic quality which he may not express by its means. Form and color and composition are his materials as they are the painter's, and if he does not, like the figure-painter, represent human emotions, he does more than the landscape-painter who represents the things which excite these emotions — he, the creator of landscapes, actually creates these things.

I visited not long ago the home of a man who had devoted a great part of his life to the study of landscape arrangements. He thought he had devoted it simply to "the study of nature." Artists in paint were personally unknown to him, as were their professional theories, their systems and ideals, and their ways of looking at things in general. It was all the more interesting, therefore, to find how exactly his ways of thinking and looking, of theorizing and working were like theirs. Breadth, simplicity, appropriateness, concentration of interest, variety in unity — these were words perpetually in his mouth. The principles of composition — in perspective, in color, in lights and darks, and in light and shadow — upon which he had worked were precisely the same as those upon which a good landscape-painter works; and he had just as keen a sense of the general impression he wished to produce — the sentiment he wished to convey — as any other artist. His flowers were placed not where they would look well seen only close at hand, but where they would "tell" well in the landscape picture as a whole. Every foot of ground which was reflected in his little lake was planted not for itself only, but for the lake's reflections also — even a group of great poppies, high up on the bank, having been set there that a red stain might show in the water below the yellow stains caused by great clusters of hardy azaleas. And he took as much pleasure in finding that the sky-line of his trees was beautiful against a night sky, and that their masses were beautiful under the rays of the setting sun as though his work had been carefully done on canvas. I am not sure how many of his visitors appreciated the pictures he has thus created, and he himself was surprised at the suggestion that not "the lover of nature" but the lover of art would be likely to appreciate them most. But these pictures are works of art just as truly and in just the same sense as any ever done with paint.

It is not a love for nature which gives the power to work like this. The possibility of attaining such power largely depends, of course, upon a love for that which is most beautiful in nature. But this is a strictly artistic quality. It is not the same as that love for beauties of detail which makes a man a horticulturist, nor, on the other hand, the same as that interest in nature's ways of working which makes one a scientific botanist. It is just the same in essence as that which makes one a landscape-painter, though, of course, it needs a more extended and scientific kind of knowledge for its right expression. The landscape-gardener's is, in no sense, imitative work. He sets before himself ideals nowhere perfectly realized in nature. He takes her materials to work with, but some of them he sometimes alters and all of them he strives to bring to an individual perfection, which he rarely achives. And with these materials he usually combines the architect's and the engineer's. Sometimes he takes her suggestions with regard to general effect, but often he suggests to himself as desirable effects, which, strictly speaking, are non-natural. As a consequence the result sometimes though by no means always looks as though it were a spontaneous result of nature's efforts; but it invariably is the result of a man's imagination — the expression of a man's idea with regard to how a given spot might be made more beautiful than nature had made it or could have made it.

Too little of this is understood as yet by the public. It thinks of the landscape-gardener chiefly as one who attends to matters of detail — to choosing trees individually fine, plants individually pretty, and setting them where they will be individually effective, — and as one who in large pieces of work is a clever engineer, able to lay out convenient places for popular recreation and promenade. It does not see him as an artist concerned as all artists of all sorts are, first of all with his general effects — with the production of beautiful natural scenes, greater or smaller in extent, and, very often, with the adaptation of architectural works to their surroundings. Part of its dulness is due, perhaps, to the unfortunate ambiguity of the terms by which the art and its practitioners are characterized. When the art first emancipated itself from the trammels of conventionality in England and began to try to reproduce more nearly the effects of nature when at her best, its professors thought needful to apologize for their seeming conceit in calling themselves "landscape-gardeners." To-day, this term has become so degraded, they think, by popular misconception, that they prefer to call themselves "landscape-architects," getting the title from the French title *architecte paysagiste*. That is, in the last century it seemed over-ambitious for a man to talk of designing a "landscape." But to-day we have become so familiar with the effort and yet have grown so to confound a "landscape" with a "garden," that a still more ambitious and much less exact epithet is thought desirable to accentuate the difference between the mere gardener's and the true artist's work. Surely the older and exacter term is dignified enough in itself, and surely we should learn to recognize all that it really implies. And we are gradually getting to recognize it a little better. The intending professor of the art may, I think, be sure that he must make himself an artist in landscape if he hopes to succeed in his profession fifteen or twenty years from now. The reform which has overtaken architecture in America is evidently on its way in this sister path. The day is not far distant when we shall no more confound a landscape-gardener with a mere grower of plants, than we now confound an architect with a builder or with the carpenter who can construct pretty rustic seats and arbors.

To become an artist in landscape, therefore, the first thing needful is to study *art* in the broad and fundamental meaning of the word — to study its principles as that gentleman (unconsciously) had studied them to whose work I referred above. In his case it had been accomplished simply by studying nature very widely, attentively and sympathetically for the best that she can do, and the way she does it; and, of course, by studying the concrete results of other artists in the same path as his own. And I may add that I believe both Mr. Downing and Mr. Olmsted, the two most successful landscape-gardeners we have had in America educated themselves in a similar way. Nevertheless, it is not the way to be recommended. It takes far too much time, wastes far too much effort, and pre-supposes a keenness of insight and a justness of instinct which must surely be exceptional. The quicker and more certain way — the only way to be recommended to a young man whose living depends upon speedy and thorough acquirement — is to begin by studying art as art. To learn what good color means and good composition, what breadth means and good *chiaroscuro*, and variety in unity and the harmonious placing of effective accents, one may first go to those artists, who, themselves students of nature, have codified upon canvas so much that is finest in her suggestions. All good pictures teach these things, whether they be pictures of scenery or not. A similar course of pictorial study to that pursued by intending painters is one which would vastly benefit the intending landscape-gardener; and a similar course of theoretic reading also. Nor would the observation of works of sculpture come amiss — there is nothing which more quickly trains the eye, and to train his eye to the utmost sensitiveness to forms as well as to colors and masses of light and shadow is what the landscape-gardener needs. But, of course, the works of the landscape-painter are those which will help him most. These he should

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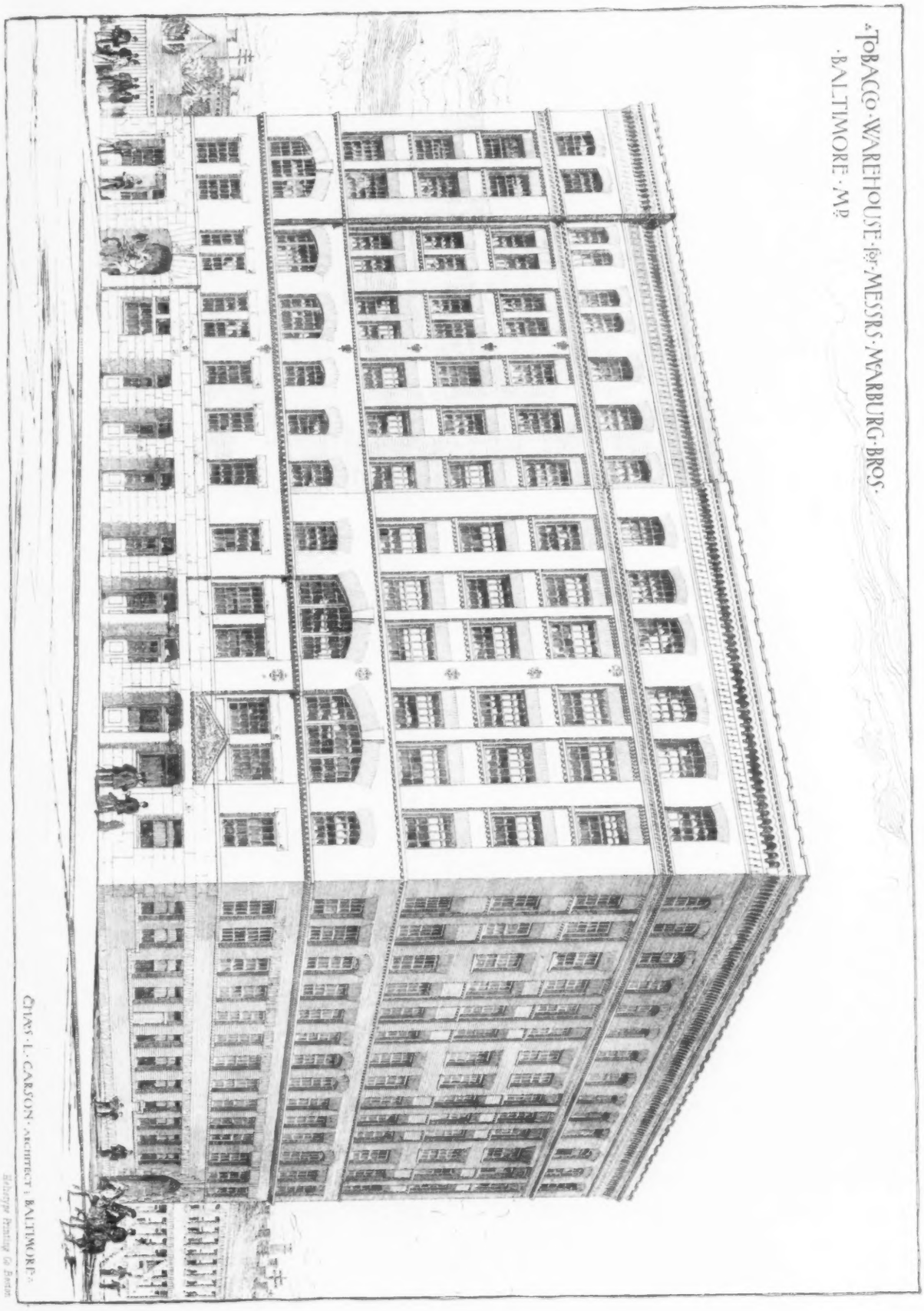

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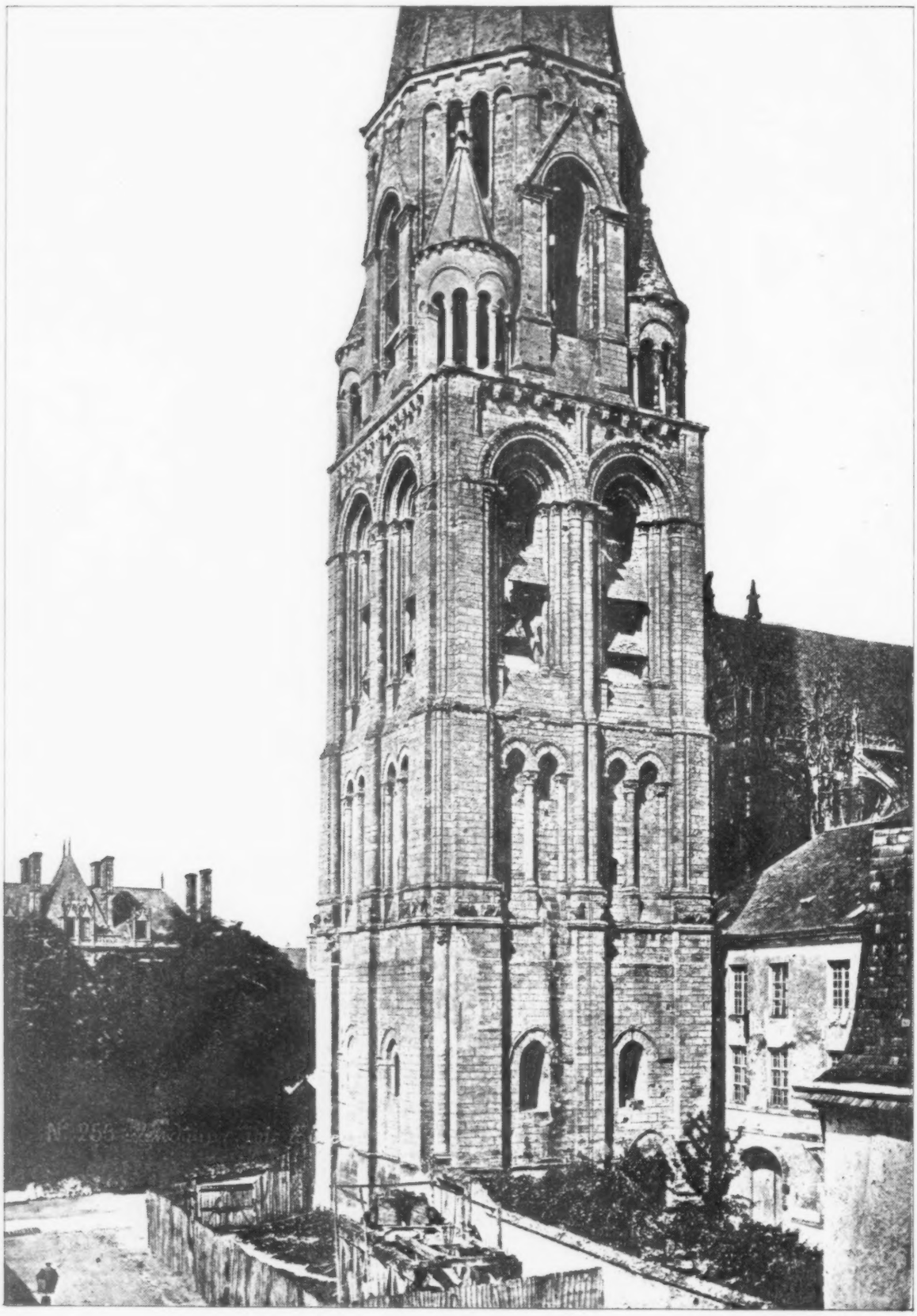

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FOUR HOUSES IN WEST 55TH ST. N.Y.
FOR C. T. BARNEY ESQ.

JAS. BROWN LORD ARCHT.
121 EAST 23RD ST. N.Y.

study very carefully, on canvas when possible, and also in those print collections which reveal the conceptions of the great masters of other times. In prints, by the way, though color is lacking, its very absence may be helpful by throwing other qualities into stronger relief.

It is needless to say that nature should be very carefully and lovingly studied, too. The learner cannot but recognize at once that in certain very important particulars his work differs from the painter's, and is vastly more difficult. He must compose, so to say, in the round. He must consider not one single point of view but many, and must find how he may best care for chief points of view without neglecting others. He must think, while composing and coloring, of the different illumination of different hours of the day, and must bear in mind the changes that will be wrought by successive seasons of the year and by successive years. He must paint for to-day but also for twenty years from to-day, and must remember that every hour of every day will give his picture a new aspect. And to learn how to do this he must study very sympathetically the changing world about him.

I do not know that a strong, youthful love for nature need be taken into account as essential to success in this profession. Such a love is a gradual growth of maturity quite as often — indeed, I think more often — than an inborn and early recognized gift. In any case it cannot better be cultivated than by learning to understand the work of nature's interpreters in art, while an eye trained upon their ideals and processes will best understand nature's practical suggestions and best put them to service in an allied art. However, it is needless to decide upon priorities in such a matter. Opportunities — the practical conditions of life — are sure to decide them in each individual case. The main thing is to keep one's eye and mind alert, and to study everything that can possibly cultivate eye and taste — not merely to look at good things and bad things with pleasure or distress, but to analyze their qualities and find out why they are pleasing or distressing. The main thing is to study both nature and art, and to study them together — so that each will explain and illustrate the beauties of the other.

Almost all writers on landscape-gardening, I may add, have strongly enforced the necessity for a training in taste other than that which the study of nature alone is likely in the majority of cases to supply. In nature the good and bad — or at least the good and less good — are too subtily intermingled for the average eye easily to distinguish between them. For this reason "the books" impress upon us the necessity of a study of painting, and none more insistently than those which represent that English generation when the art was at its best. The famous work of Sir Uvedale Price — "*A Treatise on the Picturesque*" — is a conspicuous case in point. And, to turn to the other end of the world, I may cite the feeling of the Japanese who, in certain directions at least and very likely in all, are the greatest landscape-gardeners whom the world has seen. I was talking with a Japanese friend not long ago about the way their gardening work was done, and he said that while all their gardeners were professed artists, they by themselves managed small problems only. "When a large problem is in question," he explained, "anything like one of your public parks, the general scheme is always supplied by a *painter*." M. G. VAN RENSSELAER.

[To be continued.]

THE ILLUSTRATIONS

[Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.]

BAPTIST CHURCH, NEWTON, MASS. MR. H. H. RICHARDSON, ARCHITECT.

[Gelatine Print, issued only with the Imperial Edition.]

CHRIST CHURCH, TOWANDA, PA. MESSRS. PIERCE & DOCKSTADER, ARCHITECTS, ELMIRA, N. Y.

THIS church is to be built of native white conglomerate stone. The main contract is for $19,000, and the entire cost will probably be $22,000.

TOBACCO WAREHOUSE OF MARBURG BROS., BALTIMORE, MD. MR. CHARLES E. CARSON, ARCHITECT, BALTIMORE, MD.

NATIONAL MONUMENTS. IV. — EQUESTRIAN STATUES OF NAPOLEON I, CHERBOURG, FRANCE. A. LE VEEL, SCULPTOR; PRINCE EUGENE OF SAVOY, VIENNA, AUSTRIA. FERNKORN, SCULPTOR; THE PRINCE CONSORT, EDINBURGH, SCOTLAND. STEEL [?] SCULPTOR; FREDERICK THE GREAT, BERLIN, PRUSSIA. C. RAUCH, SCULPTOR; CHARLES ALBERT, KING OF SARDINIA, TURIN, ITALY. C. MAROCHETTI, SCULPTOR, AND FREDERICK WILLIAM III, BERLIN, PRUSSIA. A. WOLFF, SCULPTOR.

TOWER OF THE ABBAYE DE LA TRINITÉ, VENDOME, FRANCE.

HOUSES FOR C. T. BARNEY, ESQ., NEW YORK, N. Y. MR. JAMES BROWN LORD, ARCHITECT, NEW YORK, N. Y.

SAFE BUILDING.—XVIII.[1]

ARCHES.

THE manner of laying arches has been described in the previous chapter, while in the first chapter was given the theory for calculating their strength; all that will be necessary, therefore, in this chapter will be a few practical examples. Before giving these, however, it will be of great assistance if we first explain the method of obtaining *graphically* the neutral axis of several surfaces, for which the arithmetical method has already been given (Article I, No. 532). To find the vertical neutral axis of two plane surfaces A B E F and B C D E, proceed as follows: Find the centres of gravity G_{II} of the former surface and G_I of the latter surface. Through these centres draw G_{II} H_{II} and G_I H_I vertically.

Neutral axis found graphically.

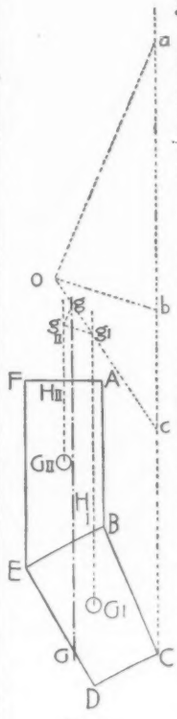


Fig. 98.

Draw a vertical line *a c* anywhere, and make *ab* at any scale equal to surface A B E F, and at same scale make *b c* = B C D E. From any point *o*, draw *o a*, *ob* and *oc*. From the point of intersection g_I of *o c* with H_I G_I, draw g_I g_{II} parallel *o b* till it intersects H_{II} G_{II} at g_{II}; from g_{II} draw g_{II} *g* parallel with *o a* till it intersects *o c* at *g*; through *g* draw *g* G vertically and this is the desired vertical neutral axis of the whole mass.

Where there are many parts the same method is used.

We will assume a segmental arch divided into five equal parts. Calling part A B C D = No. I; part D C E F = No. II, etc., and the vertical neutral axis of each part, No. I, No. II, etc.

Draw *a f* vertically and at any convenient scale, make

a b = No. I or A B C D
b c = No. II or D C E F,
c d = No. III or
d e = No. IV and
e f = No. V

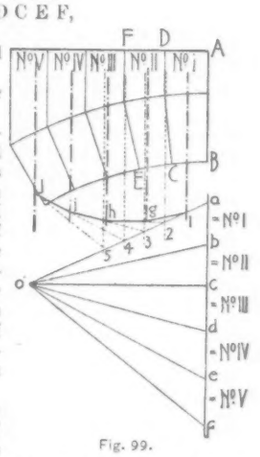


Fig. 99.

From any point *o* draw *oa*, *ob*, *oc*, *od*, *oe* and *of*.

From point of intersection I of vertical axis No. I and *oa*, draw 1 *g* parallel with *o b* till it intersects vertical axis No. II at *g*: then draw *g h* parallel with *o c* till it intersects vertical axis No. III at *h*; similarly draw *h i* parallel with *o d* to axis No. IV and *i j* parallel with *o e* to axis No. V, and, finally, draw *j* 5 parallel with *o f* till it intersects *a o* (or its prolongation) at 5. A vertical axis through 5 is the vertical neutral axis of the whole mass. Prolong *j i* till it intersects *o a* at 4, *i h* till it intersects *o a* at 3, and *h g* till it intersects *o a* at 2.

A vertical axis through 4 will then be the vertical neutral axis of the mass of Nos. I, II, III and IV; a vertical axis through 3 will be the vertical neutral axis of the mass of Nos. I, II and III; and through 2 the vertical neutral axis of the mass of Nos. I and II. Of course the axis through I is the vertical neutral axis of No. I.

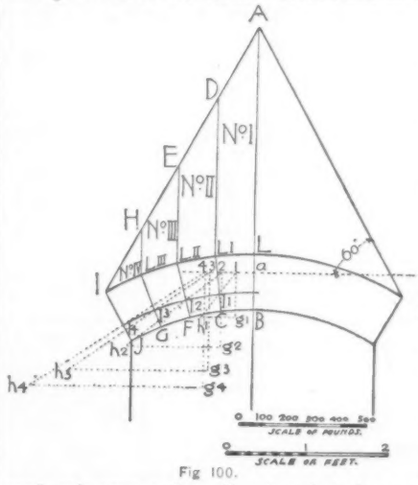


Fig. 100.

We will now take a few practical examples.

Example I.

In a solid brick wall an opening 3 feet wide is bricked over with an 8-inch arch. Is this strong enough?[2]

The thickness of the wall or arch, of course, does not matter, *where the wall is solid*, and we need only assume the wall and arch to be one foot thick. If the wall were thicker, the arch would be correspondingly thicker and

[1] Continued from page 10, No. 601.

[2] For convenience, most of the figures are duplicated: the first, showing manner of obtaining the horizontal thrust; the second, the manner of obtaining the line of pressure.

Arch in solid wall. stronger, so that in all cases where a load is evenly distributed over an arch we will always consider both as one foot thick. If a wall is hollow, or there are uneven loads, we can either take the full actual thickness of the wall, or we can proportion to one foot of thickness of the arch its proportionate share of the load.

In our example we assume everything as one foot thick. The load coming on the half-arch B J I L Fig. 100, will be enclosed by the lines A L and I A at 60° with the horizon. We divide the arch into, say, four equal voussoirs B C = C F = F G = G J. (The manner of dividing might, of course, have been arbitrary as well as equal, had we preferred.) Draw the radiating lines through C, F and G, and from their upper points draw the vertical lines to D, E and H. Now find the weight of each slice, *remembering* always to include the weight of the voussoir in each slice. We have, then, approximately,

Voussoirs arbitrary.

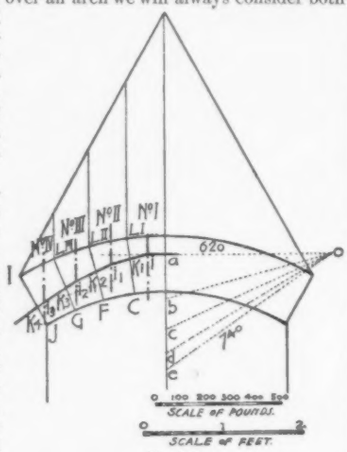


Fig. 101.

No. I	(A B C D) = 3′	x ½′ x 112 pounds	= 168	pounds
No. II	(D C F E) = 2⅜′	x ½′ x 112 "	= 119	"
No. III	(E F G H) = 1½′	x 7/16′ x 112 "	= 73	"
No. IV	(H G J I) = ⅜′	x 7/16′ x 112 "	= 43	"
		Total	= 403	"

As the arch is evidently heavily loaded at the centre, we assume the point *a* at one-third the height of B L from the top, or L $a = \frac{LB}{3} = 2\frac{2}{3}''$ and draw the horizontal line *a* 4.

As previously explained, find the neutral axes:

Horizontal pressures.

1 g_1 of part No. I,
2 g_2 of parts No. I plus No. II,
3 g_3 of parts Nos. I, II and III, and
4 g_4 of the whole half arch.

Now make at any scale 1 g_1 = 168 units = No. I; similarly at same scale 2 g_2 = 168 + 119 units = 287 = No I and No. II, and
3 g_3 = 287 + 73 units = 360 = No. I + No. II + No. III.
4 g_4 = 360 + 43 units = 403 = weight of half arch and its load.
Now make: C $l_1 = \frac{1}{4}$ C $L_1 = 2\frac{2}{3}''$.
Similarly, F $l_2 = \frac{1}{3}$ F $L_2 = 2\frac{2}{3}''$; also, G $l_3 = \frac{1}{3}$ G $L_3 = 2\frac{2}{3}''$,
And, J $l_4 = \frac{1}{3}$ J I = $2\frac{2}{3}''$.

Through g_1, g_2, g_3 and g_4 draw horizontal lines, and draw the lines 1 l_1, 2 l_2, 3 l_3 and 4 l_4 till they intersect the horizontal lines at h_1, h_2, h_3 and h_4; then will g_1 h_1 measured at same scale as 1 g, represent the horizontal thrust of A B C D; g_2 h_2 the horizontal thrust of A B F E; g_3 h_3 the horizontal thrust of A B G H and g_4 h_4 the horizontal thrust of the half arch and its load. In this case it happens that the latter is the greatest, so that we select it as our horizontal pressure, and make (in Fig. 101) *a o* = g_4 h_4 = 620 pounds, at any convenient scale.

Now (in Fig. 101) make
a b = 168 pounds = No. I.
b c = 119 " = No. II.
c d = 73 " = No. III.
d e = 43 " = No. IV.

Draw *ob*, *oc*, *od* and *oe*.

Curve of pressure. Now begin at *a*, draw *a* 1 parallel with *o a* till it intersects axis No. I at 1; from 1 draw 1 *i*, parallel with *o b* till it intersects axis No. II at *i*; from *i* draw *i*, *i*, parallel with *o c* till it intersects axis No. III at i_2; from i_2 draw i_2 i_3 parallel with *o d* till it intersects axis No. IV at i_3; from i_3 draw i_3 K_4 parallel with *o e*. A curve through the points *a*, K_1, K_2, K_3 and K_4 (where the former lines intersect the voussoir joint lines) and tangent to the line *a* 1 i_1 i_2 i_3 K_4 would be the real curve of pressure. The amount of pressure on joint C L_1 would be concentrated at K_1 and would be equal to *o b* (measured at same scale as *a b*, etc.). The pressure on joint F L_2 would be concentrated at K_2 and be equal to *o c*. The pressure on joints G L_3 would be concentrated at K_3 and equal to *o d*. The pressure on the skew-back joint J I would be concentrated at K_4 and be equal to *o e*. The latter joint evidently suffers the most, for not only has it got the greatest pressure to bear, but the curve of pressure is farther from the centre than at any other joint. We need calculate this joint only, therefore, for if it is safe, the others certainly are so, too. By scale we find that J K_4 measures $2\frac{1}{2}''$, or K_4 is (X =) $1\frac{1}{2}''$ from the centre of joint; we find further that *o e* scales 740 units, therefore (p =) *o e* = 740 pounds.

Stress at extrados and intrados.

The width of joint is, of course, 8″, and the area = 8 x 12 = 96 square inches; therefore, from Formula (44)

$$\text{Stress at edge J} = \frac{740}{96} + 6.\frac{740.\ 1\frac{1}{2}}{96.\ 8} = +16{,}26$$

and from (45)

$$\text{Stress at edge I} = \frac{740}{96} - 6.\frac{740.\ 1\frac{1}{2}}{96.\ 8} = -0{,}85$$

Or the edge J would be subject to the slight compression of 16¼ pounds, and edge at I to a tension of a little less than one pound per square inch. The arch, therefore, is more than safe.

Example II.

A four-inch rowlock brick arch is built between two iron beams, of five feet span, the radius of arch being five feet. The arch is loaded at the rate of 150 pounds per square foot. Is it safe?

Brick floor-arch.

In this case we will divide the top of arch A D into five equal sections and assume that each section carries 75 pounds — (which, of course, is not quite correct). We find the horizontal pressures (Fig. 102) $g_1 h_1$, $g_2 h_2$, etc., as before, and find

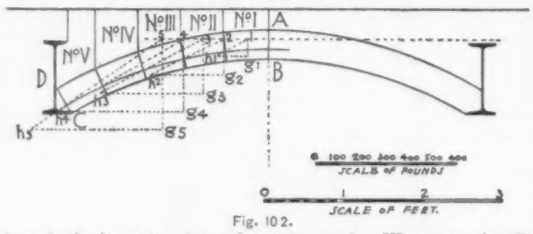


Fig. 102.

again g_5 h_5 the largest and equal to 575 pounds. We now make (Fig. 103) at any convenient scale, *o a* = g_5 h_5 = 575 pounds, and *a b* = *b c* = *c d* = *d e* = *e f* = 75 pounds and draw *o a*, *o b*, *o c*, etc. We now find the broken line *a* 1 i_1 i_2 i_3 i_4 K_5 where:

a 1 is parallel with *o a*		1 *i*, is parallel with *o b*	
i_1 i_2 "	" *o c*	i_2 i_3 "	" *o d*
i_3 i_4 "	" *o e*	i_4 K_5 "	" *o f*

In this case again evidently the greatest stress is on the skew-back joint C D, for it not only has the greatest pressure *o f*, but the curve of

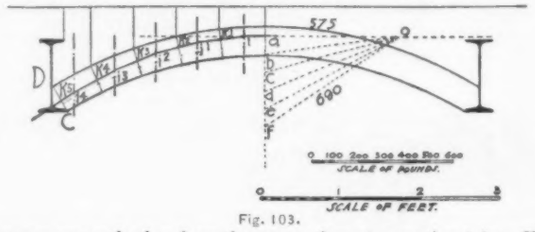


Fig. 103.

pressure passes farther from the centre than at any other joint. We find that C K_5 scales 1¼ inches, therefore the distance of K_5 from the centre is (X =) ¾″. We scale *o f* and find it scales 690 units, or (p =) 690 pounds. The joint is 4″ wide and its area = 4 x 12 = 48 square inches.

From Formulæ (44) and (45) we have then:

$$\text{Stress at C} = \frac{690}{48.} + 6.\frac{690.\ \frac{3}{4}}{48.\ 4} = +30{,}6 \text{ pounds and}$$

$$\text{Stress at D} = \frac{690}{48} - 6.\frac{690.\ \frac{3}{4}}{48.\ 4} = -1{,}8 \text{ pounds.}$$

The arch, therefore, is perfectly safe.

Glossary of Symbols.—The following letters, *in all cases*, will be found to express the same meaning, *unless distinctly otherwise stated*, viz.:—

a = *area*, in square inches.
b = *breadth*, in inches.
c = constant for *ultimate resistance to compression*, in pounds, per square inch.
d = *depth*, in inches.
e = constant for *modulus of elasticity*, in pounds-inch, that is, pounds per square inch.
f = *factor-of-safety*.
g = constant for *ultimate resistance to shearing*, per square inch, across the grain.
g_1 = constant for *ultimate resistance to shearing*, per square inch, lengthwise of the grain.
h = *height*, in inches.
i = *moment of inertia*, in inches. [See Table I.]
k = *ultimate modulus of rupture*, in pounds, per square inch.
l = *length*, in inches.
m = *moment or bending moment*, in pounds-inch.
n = *constant* in Rankine's formula for compression of long pillars. [See Table I.]
o = the *centre*.
p = the *amount* of the *left-hand re-action* (or support) of beams, in pounds.
q = the *amount* of the *right-hand re-action* (or support) of beams, in pounds.
r = *moment of resistance*, in inches. [See Table I.]
s = *strain*, in pounds.
t = constant for *ultimate resistance to tension*, in pounds, per square inch.
u = *uniform load*, in pounds.
v = *stress*, in pounds.
w = *load at centre*, in pounds.
x, y and z signify *unknown quantities*, either in pounds or inches.
δ = *total deflection*, in inches.
ρ^2 = *square of the radius of gyration*, in inches. [See Table I.]
$\mathfrak{D}$ = *diameter*, in inches.
$\mathfrak{r}$ = *radius*, in inches.
π = 3.14159, or, say, 3.1-7 signifies the *ratio of the circumference and diameter of a circle*.

If there are more than one of each kind, the second, third, etc., are indicated with the Roman numerals, as, for instance, a, a_{I}, a_{II}, a_{III}, etc., or b, b_{I}, b_{II}, b_{III}, etc.

In taking moments, or bending moments, strains, stresses, etc., to signify at what point they are taken, the letter signifying that point is added, as, for instance:—

m = moment or bending moment at *centre*.
m_A = " " " *point A*.
m_B = " " " *point B*.
m_X = " " " *point X*.
s = strain at *centre*.
s_B = " *point B*.
s_X = " *point X*.
v = stress at *centre*.
v_D = " *point D*.
v_X = " *point X*.
w = load at *centre*.
w_A = " *point A*.

Example III.

Two iron beams, five feet apart, same as before, but filled with a straight 7″ hollow fire-clay arch. The load per foot to be assumed at 140 pounds. Is the arch safe?

Fireproof floor-arch.

Of the 350 pounds on the half arch we will assume 80 pounds to come on each of the blocks and 30 pounds on the skew-back. We then (in Fig. 104) find, as before, the

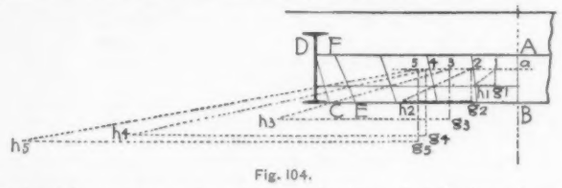


Fig. 104.

horizontal pressures, $g_1 h_1$, $g_2 h_2$, etc. Again we find the largest pressure to be $g_5 h_5$, and as it scales 2040 units, we make (in Fig. 105) at

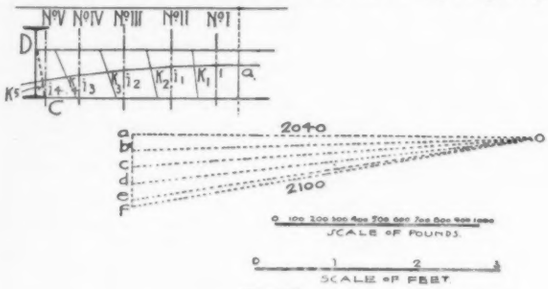


Fig. 105.

any convenient scale and place $o\,a = g_5 h_5 = 2040$ pounds. We also make $a\,b = b\,c = c\,d = d\,e = 80$ units and $e\,f = 30$ units.

Draw oa, ob, oc, etc. Drawing the lines parallel thereto, beginning at a we get the line $a\,1\ i_1\ i_2\ i_3\ i_4\ K_5$, same as before. Imagining a joint at C D this would evidently be the joint with greatest stress, for the same reasons mentioned before. We find C K_5 scales $2\frac{5}{8}''$, and as C D scales $7\frac{1}{4}''$ the point K_5 is distant from the centre of joint.

$$(X =)\ 3\tfrac{5}{8} - 2\tfrac{5}{8} = 1''$$

as $o\,f$ scales 2100 units or pounds, and the joint is $7\frac{1}{4}''$ deep with area $= 7\frac{1}{4}.\ 12 = 87$ square inches, we have:

$$\text{Stress at C} = \frac{2100}{87} + 6.\frac{2100.\ 1}{87.\ 7\frac{1}{4}} = +\ 44{,}14 \text{ pounds and}$$

$$\text{Stress at D} = \frac{2100}{87} - 6.\frac{2100.\ 1}{87.\ 7\frac{1}{4}} = +\ 4{,}14 \text{ pounds.}$$

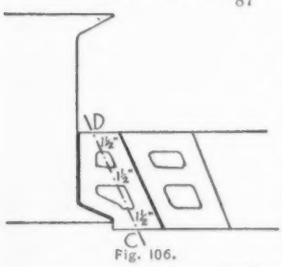


Fig. 106.

The arch, therefore, would seem perfectly safe. But the blocks are not solid; let us assume a section through the skew-back joint C D to be as per Fig. 106. We should have in Formulæ (44) and (45) x, p, and the depth of joint same as before, but for the area we should use $a = 3.1\frac{1}{2}.12 = 54$ square inches, or only the area of solid parts of block. Therefore we should have:

$$\text{Stress at C} = \frac{2100}{54} + 6.\frac{2100.\ 1}{54.\ 7\frac{1}{4}} = +\ 71 \text{ pounds, and}$$

$$\text{Stress at D} = \frac{2100}{54} - 6.\frac{2100.\ 1}{54.\ 7\frac{1}{4}} = +\ 6{,}71 \text{ pounds.}$$

There need, therefore, be no doubt about the safety of the arch.

Example IV.

Over a 20-inch brick arch of 8 feet clear span is a centre pier 16′ wide, carrying some two tons weight. On each side of pier is a window opening $2\frac{1}{2}$ feet wide, and beyond, piers similarly loaded. Is the arch safe?

Arch in front wall concentrated loads.

We divide the half arch into five equal voussoirs. The amounts and neutral axis of the different voussoirs, and loads coming over each, are indicated in circles and by arrows; thus, on the top voussoir E B (Fig. 107) we have a load of 2100 pounds, another of 62 pounds, and the weight of voussoirs or 228 pounds. The neutral axis of the three is the vertical through G_1 (Fig. 108). Again on voussoir E F (Fig. 107) we have the load 174 pounds, and weight of voussoir 228 pounds; the vertical neutral axis of the two being through G_{II} (Fig. 108). Similarly we get the neutral axis G_{III}, G_{IV} and G_V (Fig. 108) for each of the other voussoirs. Now remembering that 1 g_1 (Fig. 107) is the neutral axis of and equal to the voussoir B E and its load; 2 g_2 the neutral axis of and equal to the sum of the voussoirs B E and E F and their loads, etc., we find the horizontal thrusts $g_1 h_1$, $g_2 h_2$, $g_3 h_3$, etc. The last $g_5 h_5$ is again the largest, and we find it scales 7850 units or pounds.

The arch being heavily loaded we selected a at one-third from the top of A B. We now make (Fig. 108) $a\,o = 7850$ pounds or units

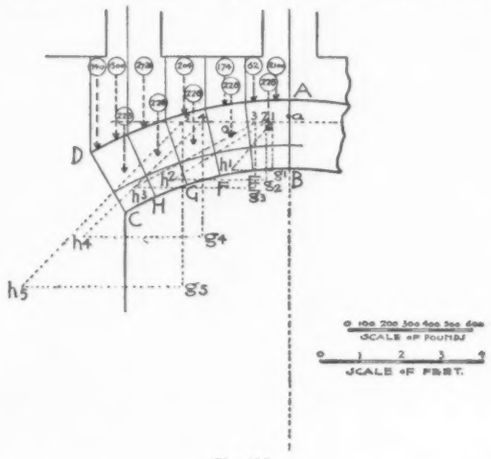


Fig. 107.

at any scale; and at same scale make $a\,b = 2390$ pounds; $b\,c = 402$ pounds; $c\,d = 432$ pounds; $d\,e = 2956$ pounds, and $e\,f = 1868$ pounds. Draw $o\,b$, $o\,c$, $o\,d$, etc. Now draw as before $a\,1$ parallel with $o\,a$ to axis G_1; also $1\,i_1$ parallel with $o\,b$ to axis G_{II}; $i_1\,i_2$ parallel with $o\,c$ to G_{III}, etc. We then again have the points a, K_1, K_2, K_3, K_4

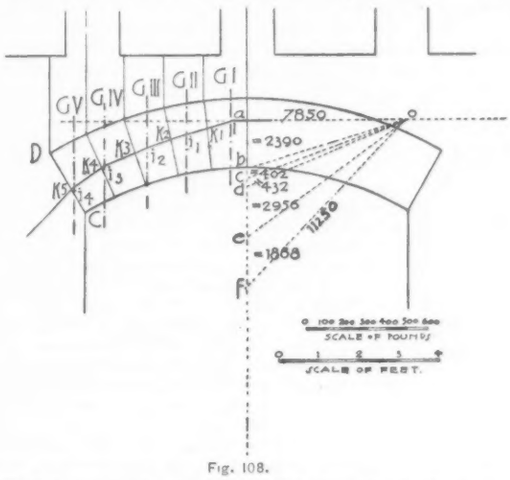


Fig. 108.

and K_5 of the curve of pressure. As K_5 is the point farthest from the centre of arch-ring and at the same time sustains the greatest pressure ($o\,f$) we need examine but the joint C D; for if this is safe so are the others. We insert, then, in Formulæ (44) and (45) for

$p = o\,f = 11250$ pounds, and as K_5 C measures $6\frac{1}{2}''$,
$x = 10'' - 6\frac{1}{2}'' = 3\frac{1}{2}''$; also as the joint is 20″ wide,
$a = 12.\ 20 = 240$ square inches.

Therefore

$$\text{Stress at C} = \frac{11250}{240} + 6.\frac{11250.\ 3\frac{1}{2}}{240.\ 20} = +\ 96 \text{ pounds, and}$$

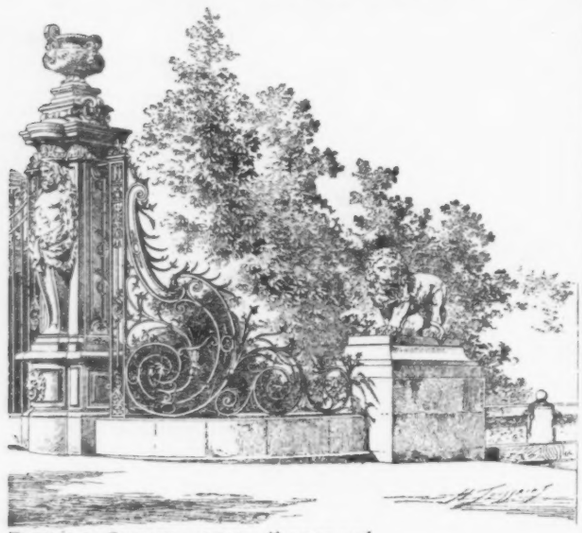
$$\text{Stress at D} = \frac{11250}{240} - 6.\frac{11250.\ 3\frac{1}{2}}{240.\ 20} = -\ 3 \text{ pounds.}$$

The arch is, therefore, safe. LOUIS DECOPPET BERG.

[To be continued.]

A ROMANCE IN OIL.—Mr. John McKeown, of Oil City, Penn., struck it rich. On the 22d of last June an oil well that he had been boring came in. It was a good well from the start. At first it yielded 80 barrels an hour. After producing at this rate a few days it was drilled deeper into the sand. A new "pay streak" was found and its production immediately increased to 140 barrels an hour. Since the 22d of June it has produced 145,000 barrels of oil, on which Mr. McKeown has realized 68 cents per barrel. He has no partners, and, owning the land in fee, has no royalty to pay. The entire output has been his own, and this amounted in the two months and four days to $98,600. The original cost of the well was about $4,000, and the expense of taking care of it since it was struck not over $500. This would leave Mr. McKeown a profit from this one well of $94,100. The well is still doing 50 barrels an hour, and experienced operators think it will turn out $150,000 worth of oil, even at the present low prices, which is why we remark that Mr. John McKeown struck it rich.—*Indianapolis Journal.*

A DAY IN MONTREAL.



From La Construction Moderne.

Of all the dreary places in this world to be detained in on a dull autumn day after an early frost has partly blighted the foliage and given it the dejected air of a recently-whipped chanticleer, and when the low clouds and the smoke from neighboring forest fires vie with one another in the processes of mystification, which add neither charm nor glamor to the objects they obscure — of all discouraging, disheartening places, there can be few to contest the palm with Montreal, metropolis of the Dominion of Canada and home of Canadian swelldom. Even on pleasant days it can hardly be an agreeable city to live in as to it is lost, through its position at the base of a low hill, one of the most unwearying of Nature's many charms, the beautiful changes that attend the slowly setting sun. To see the sun go abruptly out of sight behind the hill at the back of the city while it is still an hour high can hardly be compensated for by such reflected glories as the eastern clouds may yield. The view in front of the city is not fine enough to give excuse for placing the city on the lower level instead of on the hill itself. The choice of site seems to betoken the shop-keeping instinct of the citizens, and as the keeping of shops is the prerogative of the Englishman it is not surprising to find that the English element, social and commercial, overshadows whatever sprinkling of French sentiment and character may be found scattered through the town or in the distinctively French quarter.

Any one who visits Montreal expecting to encounter a flavor of a foreign country, a spice of things quaint and unaccustomed, will find himself grievously disappointed. He will not meet even a red coat out on leave in his shell jacket and ridiculous little fatigue cap held on an impossible spot on his head by a strap passed under his martial nose, for the English troops were withdrawn in 1870, and whatever defences there are are in the hands of the Canadian militia. An infrequent hansom-cab — which can be seen in New York, Boston or Newport, without crossing the line — is about all of a social kind that distinguishes the life here from that in any American city, if the occasional rencontre with a frocked priest of one kind or another is excepted, and, in some parts of the city, the presence of the *habitant* with his perfectly unintelligible jargon of Canadian French. English accent, English clothes, whiskers, eye-glasses met at every turn give evidence that the inhabitants, even if born on this side of the Atlantic, maintain relations with the mother country rather than with other parts of the Dominion.

The city is oppressively architectural. Hardly a building is to be seen that does not have the air of having been put into shape, with more or less success, on the drawing-board. The simple straightforward work of the work-a-day builder who contents himself with plain walls, simple roof and rectangular holes for doors and windows is conspicuous by its absence. Every building has to have as much elaboration of moulded and cut work about doors, windows and cornice as its owner's pocket will afford, and it becomes a weariness to the flesh and a vexation to the spirit to see the same things — or very nearly the same — repeated in one building after another, up one street and down the next. It is all very architectural, but it is very uninteresting, and makes one misdoubt the preëminence of the constructive art and of those who profess it. Now and then something is met which seems to have a local flavor, as a long wooden two-story block on a side street, with deep covered piazzas on both stories, and a projecting semi-circular pillared porch in the centre to give accent to the whole. But a wooden building is, in spite of wood being the staple Canadian product, a rarity in most parts of the city. Almost everything is built of the same lugubrious limestone, a dingy, slaty-colored substance, which is about as agreeable to the eye as would be a piece of frozen slush from a Pittsburgh street. Besides its initial gloom, it discolors in the same way as does the Portland stone in London's smoky atmosphere, and in the business parts of the town may be met buildings which would not look out of place amid the grime of St. Paul's Churchyard. It is a great pity it is so unpleasant a material to look at for it appears to be a most excellent building material, wearing well and of a close, fine texture that allows careful carving, so that the prevailing tendency to coarse mouldings and carvings appears to be inexcusable. To speak plainly the finish of most of the buildings appears to be made from stock patterns, so that if a moulding is to be used at all it must have members of precisely the same size as those above it or below it, or in the next street on a building of thrice the size. Until observation has convinced the wanderer that everything is really stone worked by hand, he stops frequently to satisfy himself whether the work is real stone or artificial stone cast in a mould.

Besides being so obnoxiously architectural, the city is overwhelmingly ecclesiastical. Churches meet you at every turn; sometimes you will find three out of the four corners at a street-crossing occupied by churches, all of about the same size, all of the same dismal stone, all costing apparently one as much as its neighbor, and each calling for about the same modicum of approbation from the visiting architect. One thing is very noticeable — they all seem to be complete entities; very few have the air of having reached the point where money gave out before the building was finished, as is so noticeably the case in some American cities — in Baltimore, for instance. The reason of this superabundance of vantage points for whipping the devil round the post is not far to seek: the population is a mixed one, and each race, out of sheer pride of race, perhaps, has to have a full and complete assortment of tabernacles. The Catholic element predominates, and French Canadian and Irish Canadian have to have their separate establishments, with their concomitant schools, seminaries, colleges, hospitals, orphanages and so on, with a proper force of priests, brothers, sisters, monks and nuns. The English element has its cathedral and high and low churches and its meeting-houses for the dissenters. The Scotch Established Church has to have an abiding-place and, also, various forms of Presbyterianism known in Great Britain. Besides these, all the different sects that are known in the States seem to be represented here in sooty limestone, and the peculiar architecture of the Jewish synagogue shows that the children of Israel have not been backward in providing themselves with a shelter within which they can celebrate the rites at which the outer Philistine is somewhat overprone to jeer. It would seem as though the citizens must take their pleasures sadly — except at carnival time — for placards advertising church fairs and festivals usurp on the poster-boards the places usually occupied by the announcements of the legitimate or the melo-drama. There must, of course, be theatres in a town of 180,000 inhabitants, but it was not easy to detect their whereabouts; attention is so forcibly abstracted from things secular that if, as they possibly are, they are concealed in the intestines of some block of miscellaneous structures, it is no wonder that their entrances escaped notice.

Of the really interesting buildings in the city, the one which seems to leave the most vivid impression on the memory is the Examining Warehouse, down on the levee opposite the landing of the ocean liners, which seem strangely out of place up here in the middle of Canada. The building is a rather low, irregular block of perfectly simple design, and gets its character from the three narrow, arched openings which rise nearly to the main cornice line and divide the façade into four bays. Down here, with the water near by and no foliage to throw it out of key, the limestone looks less mournful than in other parts of the city. An interesting piece of work is going on along the water-front just in front of it in the heightening of the stone embankment by a crown of wooden piling, bracing and sheathing which is designed to keep the river from overflowing its banks in the time of the spring floods, as it has hitherto had a habit of doing, the flood sometimes rising six or eight feet above the embankment and causing loss and discomfort in the buildings on the lower levels. All the sheds and warehouses on the levee have to be taken down and stored in safety when navigation closes for the winter.

The Bank of Montreal is, of course, known as an interesting building, but it is not an uncommon kind of structure, for Classic porticos as rich and pleasingly proportioned may be found in many places. There is, however, one portion of the façade worthy of note, a two-story addition at the left, the upper story treated as an attic and decorated with two or three large figures in very flat relief, which, so far as the foliage would allow them to be seen, seemed to be uncommonly graceful. It would be a benefit to this building, as it would be to most of the others in the city if the returning army of lumbermen could be turned loose in the streets next spring with instructions to thin out the trees everywhere by at least one-half. It is almost impossible to get an unobstructed view of a building except in the business streets, as the trees are everywhere obtrusive, and are most of them of just the age that you can neither see over them nor under them nor yet through them. What, when seen from a distance over housetops, seemed to be a very promising thirteenth-century French Gothic church, proved to be almost invisible from the streets it fronted so full was its yard with trees of forty or fifty years' growth; and in the residential quarters, the manner in which trees surrounded

and almost grew into the windows of the houses, suggested inmates of pallid complexion and anything but robust physique.

The next most impressive and interesting building is the great unfinished Church of St. Pierre, which is intended to be a reproduction, at a reduced scale, of St. Peter's at Rome. When first seen one is disposed to think that the game was hardly worth the candle, but the more often it catches the eye from one part of the city or another the more it gains in impressiveness. It is in a most interesting stage of construction, the shell of the building finished and the exterior in the main complete, the front portico and the pavilion domes only being lacking. But the interior is as yet untouched, though free from builders' scaffolding, and offers every chance for a study of the construction. As the wanderer passes in and out amongst the great piers and gazes up into the great brick-lined dome the regret is ever present that a grand opportunity for creating one of the most awe-awakening church interiors in the country is, in all probability, to be frittered away: that the simple masses of the constructive members, which have the grandeur that belongs to mass and simplicity, are to be concealed by an interior finish of woodwork which, after the Roman Catholic method, is to be maltreated with color decoration which rarely succeeds in being anything more than tawdry in its vulgar excess. Even the interior of the Cathedral of Nôtre Dame, not far away, which has the merit of being the largest in the country, looks loud and commonplace in spite of the fact that the decoration, which is quite new, was copied from that of the Sainte Chapelle at Paris. What is there rich and quiet and toned to harmony by the light through the stained window, is here unsatisfactory, partly because there is so much more of it, partly because there are no stained windows to speak of, and partly because the great length of the nave throws everything into perspective, with the curious result that the entire surface seems to be gilded, for the gold being applied mainly to the outer angles and projecting features catches the light, and by its glare conceals the color of the surfaces to which it is applied. It is splendid, perhaps, but it is new and garish and tiresome. The exterior, if one leaves out of consideration the great western entrance-arches, is disappointing.

The English Cathedral, Christ Church, is, on the other hand, about as interesting a piece of modern Gothic work as can be found in this country, so far as general design and proportion are concerned, but the detail is bad, bald and coarse, and the interior a very barn in its repellant bareness. The omnipresent limestone here takes on a curiously purple tone in compliment to the trimmings of Caen stone, which, on the other hand, become too obtrusive by reason of their juxtaposition with the melancholy material which composes the main mass of the buildings. An interesting chapter-house and an Eleanor's-cross kind of a structure serve to add interest and character to the group.

In the McGill University grounds is the Redpath Museum of Natural History which has quite the air of having stepped out of a page of Hittorf, and at first sight seems very interesting, though very high-shouldered, owing to the narrowness of its front and its position on a terrace. It is not helped by being squeezed up against the back of the neighboring Presbyterian College, a group in an extremely Montrealesque phase of modern Gothic. There was no one to tell which building had been built first, but if the museum was the one last built those responsible for the selection of the site were extremely injudicious.

The one other interesting building to be discovered was that built by the Standard Life Assurance Association, which would be considered a good building anywhere, but here attains unapproachable preeminence from the fact that it appears to be the only building in the city which is built of red sandstone. This fact alone would warrant the giving of an order to the attendant Jehu to rein in his steed and allow his fares to rest their eyes with something more than a passing glimpse of a bit of color. On the whole, Montreal is an interesting and instructive place to visit, but the lesson it most persistently teaches is what it is well to avoid.

SOCIETIES

AMERICAN INSTITUTE OF ARCHITECTS.

AT a meeting of the Board of Trustees A. I. A., held September 21, the following candidates were elected Fellows, viz.: M. L. Beers, D. H. Burnham, H. L. Gay, H. W. Hill, Wm. Holabird, J. W. Root, S. V. Shipman, J. L. Silsbee and A. Smith, all of Chicago. And the following were elected Associates: Otis Dockstader, Elmira, N. Y., Alfred F. Pashley, Chicago, Geo. W. Bunting, Oscar D. Bohlen, R. P. Daggett, James B. Lizius, J. H. Scharn, Adolph Scherrer, all of Indianapolis, Ind., and Chas. P. H. Gilbert, of New York City.

The Societies of Architects in Washington, D. C., and Indianapolis, Ind., were, on application, admitted as Chapters of the Institute.

The officers and members of the Washington Chapter are as follows: J. L. Smithmeyer, President; W. M. Poindexter, Vice-President; Glenn Brown, Secretary; C. A. Didden, Treasurer. Professional members: J. L. Smithmeyer, F. A. I. A., John Moser, F. A. I. A., O. Von Nerta, A. A. I. A., S. M. Howard, A. A. I. A., W. M. Poindexter, A. A. I. A., J. A. Henry Flemmer, J. R. Marshall, C. A. Didden, A. A. I. A., Glenn Brown, F. A. I. A., C. H. Reid, T. F. Schneider, A. A. I. A., Robert Stead, Wm. Kirkus, Jr., Henry H. Law, Paul Schultze, Adolph Cluss, F. A. I. A., Jos. C. Hornblower, J. West Wagner, Will. A. Freret, Edward Clark, H. L. Page, H. H. Kendall.

The Secretaries of the A. I. A., the W. A. A., the A. L. N. Y., and of each Chapter of the Institute, are *ex off.* Corresponding Members.

The membership of the Indianapolis Chapter consists of the gentlemen in Indianapolis just elected to Associateship in the Institute, together with Mr. D. A. Bohlen, F. A. I. A., its President, Mr. Lizius being the Secretary. A. J. BLOOR, *Secretary.*

COMMUNICATIONS

CORRECTIONS.

SOME weeks ago, in this department, we printed a communication, with additional comments of our own which reflected severely upon a circular issued by Messrs. Joel Goldthwait & Co.

We have since learned that the circular in question was not intended to bear the interpretation which we put upon it, and that our remarks have done injustice to an old and honorable house, and have, perhaps, created a misapprehension as to their purposes.

Such injustice and misapprehension we desire to remove as promptly and fully as possible by withdrawing and apologizing for such criticism. We are never intentionally unjust, and we desire to express our sincere regret for our error towards Messrs. Goldthwait & Co., and we trust that any papers which may have copied our original remarks will join us in publishing this correction.

EDITORS AMERICAN ARCHITECT.

GALVESTON, TEXAS, September 14, 1887.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs, — In giving the list of building-work now in my office, in your issue of August 27, Mr. Geo. Sealy's residence was inadvertently stated as one of my buildings. I wish to correct this clerical error, and to say that I am the superintendent of construction for Messrs. McKim, Mead & White, of New York, who are the architects of this building. Respectfully yours, N. J. CLAYTON.

TO LEARN PERSPECTIVE DRAWING.

BALTIMORE, September 18, 1887.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs, — Will you kindly advise me as to the best way of obtaining a thorough knowledge of perspective drawing?

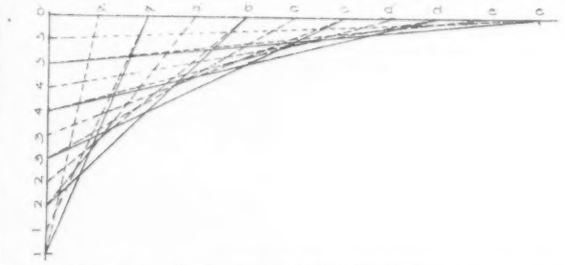
By conferring a favor in letter or paper, you will greatly oblige a subscriber. Yours very truly, EDGAR M. LAZARUS.

[MAKE a thorough study of Ware's "*Modern Perspective*," published by Ticknor & Co., Boston. — EDS. AMERICAN ARCHITECT.]

"HOW TO DRAW AN ELLIPSE"?

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs, — In looking over the back numbers of the *American Architect* I came across, in Volume X, No. 293 (August 6, 1881), the short article with the above heading (without the interrogation). As a matter of curiosity, as well as being desirous of knowing the "short way" of laying out work, I tried it. I divide, in the figure shown, each semi-diameter into *five* equal parts — *a*, *b*, *c*, etc., and 1, 2, 3, etc. — and proceeded as described. Not having as many points as necessary by which to draw in the curve, I divided each part into two, making ten equal parts in each, and proceeded as before. This showed me the error of the method given, as it made two sets of lines (the solid and dotted shown), one within the other, which were to be tangent to the curve and making it possible to draw *two* ellipses to the same two diameters, which, of course, is impossible. Again, line 1–*a* is a different line from 1–*a'*, and the same curve cannot have both tangent to it. I also do not see how a curve which has either 1–*a* or 1–*a'* tangent to it can pass through the point 1, as a true ellipse is obliged to do. I address this to you, hoping to be corrected if wrong or in any



way misunderstand the rule, but if right, that you will save many from its error by the publication of this. Yours truly, "S."

[The paragraph in No. 293 needs correction, and we are glad to have our attention called to it. If the half span and the half rise are each divided into five parts, the first line should be drawn from 2 to *a*. Dividing into ten parts, the first line will be from 1′ to *a*′. In this way all the diagonals will be tangent to the same curve, no matter how many parts the horizontal and vertical lines may be divided into. The curve, by the way, is not a true ellipse, but is composed of portions of two parabolas.—Eds. American Architect.]

NOTES & CLIPPINGS

Comfort for Advertisers.—Frank R. Stockton at one time suffered much pain in his eyes and was forbidden to read. The first day that the doctor granted him half an hour with a book his friends were curious to know what book he would select. "Give me some advertisements," he demanded, and explained, as a shout was raised, "Yes, I am pining for advertisements. My wife has read everything else aloud to me, but I hadn't the heart to ask her to read the advertisements." For several days he devoted the whole of that precious half hour to advertisements.— *The Epoch.*

Moving a Railroad Bridge in Eleven Minutes.—Two thousand people saw some wonderful achievements of engineering skill at Holmesburg Junction, on the New York division of the Pennsylvania Railroad, a short time ago, says the Philadelphia *Times*. Thirty-two men moved a distance of 50 feet the iron bridge, weighing 160 tons, that spans the Pennypack, and they accomplished the great task in the remarkable time of 11¼ minutes. The engineers of the road had been long making preparations for this work. Some time ago the company decided to build a four-arched stone bridge in the place of the iron structure over the big creek. The iron bridge had to be moved westward 50 feet that it might be used until the stone bridge is built and ready for service. The removal of the bridge had to be magic-like, and between the running of fast trains. Six weeks ago the men began the big undertaking with the building of trestle approaches to both sides of the creek at the point where the iron bridge was to find a new bed. The trestling has an average height of 25 feet, and is on a level with the grade of the old road-bed. The timbers of the western approach covered about 276 feet, while the eastern approach is 300 feet long. Piles were then driven in the middle of the stream, on which was reared a strong trestle-work 50 feet long and on a level with and contiguous to the stone-pier under the bridge. Trestles of the same length and height were then built on both banks of the creek and in a continuous line from the stone abutments. These timbers were to serve both as the resting-place and as a carriage-way over which the 24-foot wide and 180-foot long bridge was to be gently moved to its new foundation. Two iron rails were then laid along the new wooden pier in the stream, and two rails on either of the new wooden abutments, and then the rails were slipped under the centre and both ends of the bridge. The rails were well greased. A "crab" is a windlass with an iron chain, and is made of heavy iron, and is triangular in shape. Four compound and four single-geared "crabs" were placed on the bridge, two at each end and four in the middle. The end of their chains were then fastened to the head of the new wooden pier on the new abutments, and the bridge was ready to be wound across the slippery rails. Long before the hour for moving it people began to flock to the scene. They came on trains, on foot, and in nondescript vehicles. An army of workmen appeared. Over 300 Italian and Irish laborers were marshalled on both sides of the bridge, while four gangs of carpenters were under it. Every man was at his post, and the great throng of people was watching with eager interest, when the whistle of the "fast line" was heard, and the train thundered over the bridge, seven minutes late. As it dashed away Superintendent Ford gave a word to his army of laborers, and it was a scene of transitory animation as they tore up rails and cut away the fastenings of the bridge. The bridge had no sooner been released than Master-mechanic Mershon gave the signal and the 32 men began to wind the "crabs." As the bridge began to slowly move men went in front of it, pouring oil over the tallow-greased rails. Superintendent Crawford and the other officers held watches in their hands as the big iron structure moved calmly toward the end of the trestling. At one time the eastern end began to lag, but it was only for a few moments, and soon the bridge slid over the rails foot by foot to its resting-place without a mishap, and in the brief period of 11¼ minutes, while a mighty roar went up from the people. With lightning-like rapidity the toilers on both sides of the creek tore up and laid down frogs, switchers, sleepers, and moved the rails to their new bed. They soon had the rails connected with the two tracks on the bridge. A half-hour after the bridge had been cut loose a heavy construction-train was run over the structure, and at 12:19 the Philadelphia express dashed across.

Preservation of Stone.—Limestones are, for many reasons, eminently suitable for constructive purposes, being cheap and easily-worked, but they readily absorb moisture. This, as it usually contains carbonic acid, gradually dissolves away the material of the stone, and in winter serious injury is often caused by the freezing of this water and its consequent expansion. Several methods of rendering this material less porous have been proposed, but not unfrequently the remedy has been worse than the disease. Alkaline silicates were at one time in favor for this purpose, but in its application soluble hygroscopic alkaline carbonates are formed which seriously affect the utility of the process. Moreover, unless care is taken in the application of these silicates a hard impervious varnish is given to the surface of the stone, within which the water used in dissolving the silicates is imprisoned, and on the first frost serious disintegration takes place. MM. Faure and Kessler have recently been at work on this question, and as the result of their experiments recommend the use of metallic fluosilicates, more especially those of aluminum, magnesium, and zinc. The surfaces to be treated are brushed over with a solution of the salt chosen, causing on the first application an abundant froth, due to the liberation of carbonic acid gas. When dry the operation is repeated once or twice, depending on the quality of stone, on an average for soft stones 1.7 pounds of solution at 40° Beaumé are required per cubic yard. The advantages claimed are: That the process is completed in twenty-four hours; it allows the stone to be polished, and by a suitable choice of fluosilicate used different colors can be communicated to it; and lastly, the process is cheap, and applicable not only to stone, but to all cements and mortars containing lime. The theory of the process is that a double decomposition occurs, forming in the first place, silica, calcium, and aluminium fluorides, and carbonic acid gas; secondly, a reaction takes place between the limestone and the aluminum fluorides, producing alumina, calcium fluoride, and carbonic acid. In this manner each grain of the limestone is covered with an insoluble coat, materially increasing its resistance to atmospheric influences.— *Engineering.*

TRADE SURVEYS

In nearly all lines of trade the September volume of business has been from ten to twenty per cent in excess of what it was a year ago. At this time an extraordinary distribution of goods is in progress in all parts of the country. No section of the country seems to stand out from the rest in this activity, but all are in the enjoyment of a greater degree of prosperity than usual. The manufacturing-interests have been shouting all along the line "go slowly," at the same time straining every energy to expand capacity and extend trade. No harm has resulted from this feverishness, and in all trade and manufacturing journals there seems to be a feeling that no harm is within twelve to twenty-four months. Builders who have lately spoken for themselves say that notwithstanding the financial flurry there is a vast amount of work being projected for next year. Some who ought to know predict that manufactory building will be more extensive next year than this, the reason given being that the extraordinary demand this year for all manufactured products will force an expansion of manufacturing capacity. The probabilities point strongly that way, and numerous interesting details could be summarized to strengthen the pleasing prediction, such as the urgent demand for every sort of machinery, tools, railway rolling-stock and equipments and electrical appliances, motors, etc. The increase in manufacturing establishments this year has certainly been phenomenal, and all are crowded with business as soon as wheels are ready to turn. Ship-builders of national repute on the Delaware predict several years of great activity in ship and boat yards, and prominent railroaders say that the railway-supply facilities will be crowded for an indefinite period. The present dulness in rails will soon disappear, and an advance in prices is regarded as probable, though this advance will be held in check by foreign quotations. Iron and steel makers are overrun with winter work, and prices are strong. Bridge-builders have the greatest winter's work before them they have ever had. Hardware factories, tool-makers, boiler and engine shops, and a multitude of small industrial establishments that cannot be classified are at this time sold from one to three months ahead. Hence it is but reasonable to expect a further expansion in 1888, and particularly in the new States. The Western builders have every confidence in a renewal of building activity, and in this hope they are encouraged by the best-known architects of the West, many of whom now have large contracts in hand. It is well to be able to record the fact that there is a very strong conservative feeling in trade, manufacturing and railroad circles. The necessity for a new work is carefully weighed. This spirit runs all through the industries. An urgent necessity must first exist before new enterprises are undertaken. There is less ignorant and more intelligent enterprise at the helm, and hence fewer failures, less weakness, more confidence, and a more evenly-balanced condition of production and consumption. The manufacturers of building material have entered upon an enlargement of buildings and facilities in general. In five cities where special inquiries have been made thirty new brick-working concerns will be making brick next year. On this basis a fair guess would give three or four hundred new and enlarged brick-concerns next year, and, if the truth were known, this might be a trifling number. Brick has been leaning towards scarcity all summer. In lumber, trade has, within two weeks, been stimulated in all the leading Western cities, and all Northwestern lumber manufacturers and dealers are having a large trade, but the abundance of all kinds of lumber renders high or even firm prices impossible. The manufacturers of builders' hardware and the makers of small tools report excellent winter and spring prospects. The architects corroborate most of the statements made as to the next year's activity, and go farther than mere outward facts to discount the future. They see logical reasons for saying that next year must be a very busy year in general building. There are good projects for mill and factory building in the New England States. The wage-workers of this section are in better condition as consumers than for years, a fact indicated in a measure by savings-banks reports. In the Middle States employment has been abundant and remunerative. Much shop and store building is to be undertaken in New York and Pennsylvania in the spring, and four or five long natural-gas pipe-lines will be laid, besides the construction of very large manufacturing establishments. Illinois, Iowa and Missouri seem at present to lead in enterprise in the West, as to manufacturing, those States serving the farther West with products, as did Pennsylvania and Ohio a few years ago. Business prospects are certainly encouraging to new men, and hundreds of them are being encouraged by the swelling tide of trade and business to plunge in. The latest statements as to railway earnings for eight months show an increase of fourteen per cent on the one hundred and eight roads reporting against nineteen per cent increase for the same mileage for same time 1885. The American export-trade does not show up so well as it might because of the extraordinary home demands which monopolize attention. The foundation for such a trade is being laid outside of the domain of legislation or unduly-stimulated enterprise. The competition of the lower-priced but actually-dearer labor of other countries cannot be easily overcome in the face of urgent demands and inviting opportunities at home. Financiers have been making a sham fire of the stringency of money, and those who attempt to manipulate the market will come to the same end as did the wheat-speculators and the other smaller fish who have been trying to corner the markets. Money is not as abundant as it ought to be for the fullest expansion of the nations' capabilities, but practical ways and means will suggest themselves as soon as the stringency becomes unbearable, if it ever does.

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No. 64. SATURDAY, OCTOBER 1, 1887. Volume XXII. No. 614.

FUEL CARTRIDGES.

Several suits, in which prominent men of this city will figure, will soon furnish comment to the public, says the Troy *Press*. The securing of a patent on a Fuel Bomb by the Troy Globe Ventilator Company will be the cause of the suits. On April 30, 1872, David W. Thompson, who then resided at St. Joseph, Missouri, invented what is known as a "Fuel or Earth Cartridge." Mr. Thompson obtained United States letters patent, the claim of which was: "A fire-kindler consisting essentially, of a perforated metal case and a porous absorbent filling." In the second claim the article reads: "A handle combined with, and secured within the case." The Fuel Bomb is simple in construction, consisting of a shell of 4 x 5 inches, having metal edges and a wire gauze body. Mineral wool is placed in the shell, and saturated with kerosene, and then the affair is placed in the stove for use. The shell is very handy, throws considerable heat, and is considered by many far more convenient for household purposes than the oil-stove. Mr. Thompson also patented, July 2, 1872, a can for holding and filling the shell with kerosene or other combustible fluids. On or about the 1st of July, 1887, a cartridge which was termed an "indestructable fuel cartridge" was placed on the market by the "Coupon Introduction Company," at Nos. 39 and 41 Cortland Street, New York City. The sale of the article up to the 2d of August, according to the company's advertisement in the New York *World* of August 7, 1887, was upwards of 211,000. The Coupon Company did not possess a patent, but they sold the goods, which were marked "patent pending." The Company had applied for a patent, but it is understood that a patent was disallowed. The Coupon Company was aware of Mr. Thompson's patent on the shell and endeavored to trace the patentee. But the Company failed in their search, Mr. Thompson having moved from St. Joseph some thirteen years ago. The banks, postmasters and mercantile agencies were unable to tell where Mr. Thompson resided. The Company was in a quandary, and all search for the patentee thereafter was futile. The Globe Ventilator Company of this city, with commendable enterprise, about a month ago conceived the idea of manufacturing a fuel bomb. The Company came across Thompson's patent. A search for Thompson was instituted, and A. J. Farley, the travelling agent of the Company, set out from Troy about the latter part of last month to look up the inventor of the bomb. Mr. Farley travelled some 8,000 or 10,000 miles before he discovered that Mr. Thompson had moved to Englewood, Ill., one of Chicago's suburbs. Mr. Farley found Mrs. Thompson at her home, where he also found one of the original fire-kindlers which had been made by Thompson thirteen years ago. Mrs. Thompson informed the agent that her husband was now travelling for Emerson & Co., shoe manufacturers of Haverhill, Mass., of which firm Mr. Thompson is one of the members. Mrs. Thompson did not know of her husband's exact whereabouts, but he was expected in Buffalo, N. Y., within a few days. Mr. Farley at once retraced his steps to Buffalo, and eventually found the object of his search.

Mr. Thompson was already cognizant of the great sale which his article had attained. He asked Mr. Farley for a much larger price to relinquish his claim than the Globe Ventilator Company were willing to give. Mr. Thompson was at last brought to name a special figure, which was agreeable to the Company. The patents and all "chose in action" in every back claim were assigned to the Troy Company. The Globe Ventilator Company has now commenced suit against George S. Geer of this city and the Fuel Cartridge Company of New York City, in which $200,000 damages is claimed for infringement on the Company's patent. A suit will also immediately be begun against the Earth Fuel Company of No. 2 Platt Street, New York, for a royalty on the goods they have manufactured. All other infringements will at once be prosecuted. Torrance & Company and Hoyt & Wynkoop, both firms of this city, who have been making castings, and J. B. Maltby, also of Troy, who has been furnishing wire cloth for the manufacture of the cartridges, and all others who have been furnishing any material for Mr. Geer for the manufacture of these goods have been informed that they must stop doing the same. The Globe Ventilator Company are now manufacturing the article under the name of "Imperishable Fuel Bomb." The Company will this week commence supplying the trade. It was this article with which Mr. Geer some time ago created a sensation in New York police circles by having one of the bombs placed in Inspector's Byrne's quarters, and when found it was thought an attempt had been made to take his life.

GLOBE VENTILATOR CO.,
TROY, N. Y.

DEFYING THE FIRE.

People passing the Terrace near Police Headquarters during the past two weeks, says the Buffalo *Express*, of August 17, have wondered what a little square brick building about ten feet wide and ten feet high stood out in the street for. The mystery was solved yesterday afternoon when a crowd gathered about the little structure at a respectable distance away from it. A blazing fire was raging on the ground within, and, as a small boy said, the experiment, for such it proved to be, would have been a very nice one to try in winter.

A test was being made of the fire-resisting qualities of the John A. Roebling's Sons Company fireproof patent stiffened wire-lathing. The wire cloth which constitutes this lathing was stretched across the planks at the ceiling of the temporary structure and two coats of mortar had been applied to it. A small portion of the bare brick wall near the ceiling was also coated with the lathing and mortar. Plenty of fuel was brought from a neighboring planing-mill, and for over an hour the little house was almost as hot as a smelting furnace. It was not long before the very walls began to crack and give way, and a bar of iron which formed the top of an opening near the floor was visibly bent. When the fire was extinguished examination showed that the test had been entirely satisfactory. Owing to the cracking of the side walls the mortar had fallen from them in places, but the ceiling was almost intact, the wire lathing not damaged in the least, and the wood above unharmed. The throwing of water upon the ceiling while yet hot had the effect, as was expected, of cracking the mortar, leaving the lathing with one coat ready for another application.

An interested witness of the test was Mr. W. W. Carlin, the well-known architect, at whose instance it was made. He expressed himself as well satisfied. The wire lathing is manufactured by the New Jersey Wire-Cloth Company. John A. Roebling's Sons Company, the fame of whose name has been made world-wide by their connection with the great Brooklyn Bridge, are the agents. Mr. H. L. Shippy is the manager of the New York office at No. 117 Liberty Street. There are offices at Chicago, No. 217 Lake Street, and San Francisco, No. 14 Drumm Street; and Mr. R. T. Brown is the agent for the Company for Buffalo with headquarters in New York.

In this connection it may be well to recall an experiment with this wire cloth which, while successful, was not made by design. It happened several years ago at the Harvard Medical School, Boston. A fire occurred in one of the rooms, the walls of which were brick, with wooden joists, and the ceiling fitted with wire cloth, which kept the fire from

spreading after everything in the room was burnt out.

NEW JERSEY WIRE CLOTH CO.,
TRENTON, N. J.

NEW CATALOGUE.

MESSRS. EDWARD E. GOLD & COMPANY have just issued a new illustrated catalogue descriptive of their Compound Coil Heaters, patent steam trap, "Reliable" Water Feeder, etc. Of their Compound Coil Indirect Heaters they say: "The winding of coils, of number fourteen square wire, of strong elastic tension, around one-inch pipes of common return-bend coils (two pipes high), constitutes the main feature of this invention; while enclosing the same in substantial casings, lined with tin, which serve both for shipping and for the final adjustment of the stacks beneath hot-air pipes and registers, simplifies the almost endless details of steam or hot-water heating construction. This plan combines compactness, lightness, strength, rapidity of circulation, durability, and great economy of time and labor in erection. It adds to the advantages above enumerated great heating power, as it is impossible for a volume of air to pass through this heater stack without being completely and promptly warmed, as the main current is broken into innumerable smaller currents by means of the hot coils. These coils, by reason of their elastic force and spiral form, closely embrace and press the pipe at every point of contact therewith, thereby securing a great amount of extended heating surface of the most effective kind. Owing to this novel method of securing extended heating surface, the distance travelled by the steam or water, the number of joints and fittings, and the space occupied is less than one-quarter that of ordinary return-bend coils of equal heating power; hence the circulation is perfect, and freezing is wholly avoided.

Its weight is less than one-half that of cast-iron radiators, or ordinary box-coils; hence a great saving is effected in freight and cartage. Each stack, after having been tested to one hundred pounds to the square inch, hydraulic pressure, is then enclosed in a substantial casing of wood, lined with tin and ready for erection; thus saving the expense of carpenter, heavy hangers, bearers, etc., necessary in ordinary construction. These stacks are manufactured in various sizes, adapted for rooms of from five hundred to five thousand cubic feet capacity. The number of square feet is distinctly marked on each box, warranted to have a heating power equal to the same number of square feet made up of any indirect radiating surface in the market.

Testimonials from a few of the parties who are using the "Compound Coil Heaters":

[From J. Gould, Esq., 579 Fifth Avenue, New York.]

NEW YORK, January 6, 1885.

Messrs. Edward E. Gold & Co.:

Gentlemen, — The Low-Pressure Steam-Heating Apparatus you placed in my residence, cor. of Fifth Avenue and Forty-seventh Street in the fall of 1884, has given me entire satisfaction.

The great volume of pure fresh air, moderately heated, produced by your Compound Coil Heaters, give an agreeable temperature and perfect ventilation. I most cheerfully recommend the same. Very respectfully,

Jay Gould.

[From Hon. Russell Sage, 71 Broadway, New York.]

NEW YORK, January 11, 1886.

Messrs. Edward E. Gold & Co.:

The Steam-Heating Apparatus you put in my dwelling, No. 506 Fifth Avenue, as well as others in my dwellings on Madison Avenue, some three years ago, have given entire satisfaction. I can fairly add that they possess great heat-producing power and supply air of the best quality, for health, comfort, neatness, and economy.

I want to add a few words as to the working of one of your "Compound Coil Direct Heaters" attached to the steam apparatus in my office, No. 71 Broadway.

It has been in use about three years, and has proved all that could be desired in giving pure heated air, and enough of it to heat my office in the coldest of weather, and easily managed at all times. I consider it, as well as your dwelling heaters, among the very best heating apparatus in use at the present time, and as such I cheerfully recommend them. You are at liberty to refer to me any one in want of a heater, and also to give permission to examine the working of the heater, and see its completeness in working and its comeliness in appearance.

Respectfully yours, Russell Sage.

[From W. R. Vermiyle, Esq., Englewood, New Jersey.]

NEW YORK, March 29, 1882.

S. F. Gold, Esq.:

Dear Sir, — I have had considerable experience during the past fifteen years with Steam-Heating Apparatus (both cast and wrought iron), but have never had my house comfortably warmed until the introduction of your Compound Coil Radiators last fall. My house, which is about 50 x 50, is located in a most exposed situation, and the additions built upon it during the past year rendered it more difficult to heat than ever, yet we have gone through all the cold snaps without the least inconvenience. This I am convinced is due to your improved heating surface and admirable method of taking the air to be warmed *directly from out-of-doors*. So perfectly is this cold current warmed by your improved system that the air of the building is not affected by zero weather or Northwest gales.

Another excellent feature I have observed in your apparatus is the method of running the steam and return pipes so that frost cannot affect them. In short, I am so well pleased with your work that I do not hesitate to say that *I regard your system the perfection of artificial warming*. Very truly yours,

W. Romeyn Vermiyle.

[From J. A. Crouthers, M. E., No. 12 Cortlandt Street, New York.]

NEW YORK, January 5, 1886.

Messrs. E. E. Gold & Co.:

Gents., — Replying to your request I would say I am using one of your 78-foot Compound Coil Radiators to heat a room 18 x 36 x 12 with four large windows, using steam of from one to four pounds pressure, and find that with one register open I can maintain a temperature of 70° Fahr., and with both registers open the average temperature is too high for comfort. I am perfectly satisfied with its action and operation, although when I placed it I was of the opinion that it was no better, if so good, as a plain radiator, and I now intend to place some more of them in the same house.

Yours truly, J. A. Crouthers.

[From William A. Miles, Esq., Mt. Vernon, New York.]

NEW YORK, January 23, 1886.

Edward E. Gold & Co.:

Gentlemen, — The Steam-Heating Apparatus erected by you in my residence at Chester Hill, Mount Vernon, for heating by indirect radiation, with your Compound Coil Heaters, has given us entire satisfaction. If I were building again I should not think of adopting any other system of heating. I remain, yours truly,

W. A. Miles.

[From Donald Mackay, Late President of the New York Stock Exchange.]

NEW YORK, March 24, 1882.

Samuel F. Gold, Esq.:

Dear Sir, — As winter is about passed I deem it but a duty on my part to write you and tell you how much pleased I am with the working of the "Steam-Heating Apparatus" that you

"GILBERTSON'S OLD METHOD" ROOFING PLATES.

Every Box Cuaranteed and Stamped with the Weight.
Every Sheet Stamped with the Brand and Thickness.

A tin roof should last for forty years at least, with no expense for repairs. It does not last ten years before repairs begin — nine roofs out of ten. The fault is in the tin.

From the "*Northwestern Architect and Improvement Record*," August, 1887:

What is called "enterprise" by a business house, and is admired by the world, manifests itself in one of two directions: either in rustling, as we say in the West, for business or in striving to put the best goods possible upon the market. The man or firm excelling in the latter direction finds his recompense in the gratification of a laudable pride akin to that felt by the lawyer or doctor who attains a great success in his profession regardless of the money consideration. The firm of Merchant & Co., of Philadelphia, have manifested an "enterprise" of the latter kind, not unaccompanied, however, by success in a commercial sense. A handsome circular, just issued by this house, announces the fact that Mr. Merchant, whose trip to Europe we recently chronicled, has returned, and is able to announce that hereafter every box of "Gilbertson's Old Method" and "Camaret" will be stamped with the average net weight on each box, as follows:

"GILBERTSON'S OLD METHOD" ROOFING PLATES.

IC 14 x 20	120 lbs.	IC 20 x 28	240 lbs.
IX 14 x 20	148 lbs.	IX 20 x 28	296 lbs.

"CAMARET" ROOFING PLATES.

IC 14 x 20	110 lbs.	IC 20 x 28	220 lbs.
IX 14 x 20	138 lbs.	IX 20 x 28	276 lbs.

And also that no wasters of either of the above brands will be sold to any one in England, nor will they be shipped to the United States.

MERCHANT AND CO.,
Philadelphia. New York. Chicago. London.

BURDITT & WILLIAMS,

Established 1860.

Manufacturers and Dealers in

FINE HARDWARE

— FOR —

Dwelling-Houses, Churches, Stores and Public-Buildings.

Every Excellence of Mechanism. Latest and most approved Styles and Finish

Special New Designs of Knobs in Cut-Glass. Patterns made to order from Architect's Designs. Estimates made. Contracts filled in all Markets.

20 DOCK SQUARE, BOSTON. BRANCH OFFICES: 1300 Broadway, New York. 1416 F St., Washington, D. C.

Our Hardware may be found in important buildings in the leading cities of the Country.

put in for me during last summer. Of course you are well aware of the exposed situation of my house, and that I am not shielded from the weather from any quarter of the compass, and yet we have been able at all times to keep the whole house at a pleasant temperature, without driving the furnace at any time, and in most cases when there was but little or no wind, with the fire-door partially open. Another pleasure we have derived from the use of the steam heater is a perfect freedom from dust and the smell of coal gas. Having been so thoroughly satisfied with your heater, you may, if it be your wish, refer to me. Yours truly,

Donald Mackay.

[From W. G. Warden, Esq., President Atlantic Refining Co., Philadelphia, Pa.]

PHILADELPHIA, January 20, 1886.

Messrs. Edward E. Gold & Co.:

Gentlemen, — The Low-Pressure Steam-Heating Apparatus you made and placed in my dwelling-house on School Lane, Germantown has proven very satisfactory in every way. I have two boilers connected and find I can run one or both with perfect success. The steam fitting is first-class, and has not shown a sign of leakage or given me a particle of trouble. You will remember I put in a very large extra amount of your Coils and find in the coldest weather we have the benefit of having done so, and don't regret it. Yours respectfully,

W. G. Warden.

Architects, builders and contractors should send for this catalogue and read fully the comparative tests in indirect hot-water heating given at length therein — to

EDWARD E. GOLD & COMPANY,
CORNER OF FRANKFORT AND CLIFF STREETS, NEW YORK.

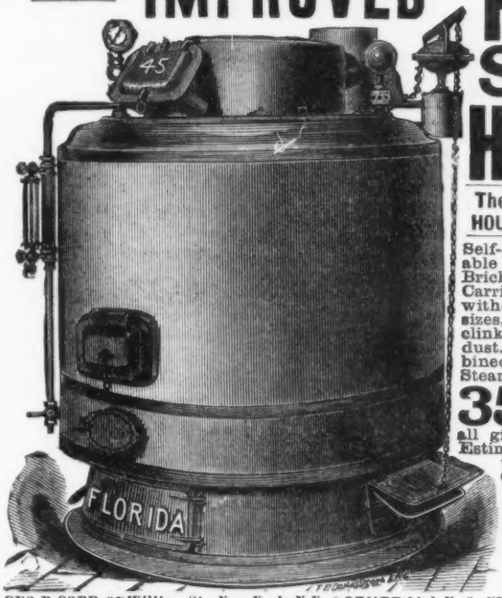
NOTES.

We call the attention of architects and builders to the advertisement of the well-known firm of Hatten, Galpin & Company, the manufacturers of eight-foot seamless gutters and eave troughs. These gentlemen inform us that they are now prepared to furnish gutters in eight-foot lengths in any special styles from architect's designs — of copper, galvanized iron, IX choicest terne and tin. A few styles that they carry in stock (all eight-foot lengths) are shown in their advertisement elsewhere in this issue.

The sales of boilers by the Babcock & Wilcox Co., for July and August, are as follows: Electric Club, New York City, 73 horse-power; Eagle Knitting Co., Elkhart, Ind., second order, 50 horse-power; Old Kentucky Woollen Mills, Louisville, Ky., second order, 104 horse-power; A. Hayward, San Mateo, Cal., 51 horse-power; Lehigh Coal and Navigation Co., Philadelphia, third order, 208 horse-power; Sibley Mills, Baltimore, Md., second order, 125 horse-power; Pacific Power Co., San Francisco, Cal., 208 horse-power; New York Steam Co., New York City, fourteenth order, 400 horse-power; New York Steam Co., New York City, fifteenth order, 250 horse-power; Edison Electric Illuminating Co. of New York, New York City, [thirty-fifth order for Edison Cos.] for three new stations, 8,700; Chicago, Burlington & Quincy R. R., Chicago, second order, 136 horse-power; St. Louis Refrigerator & Wooden Gutter Co., St. Louis, 240 horse-power; Chickies Iron Co., Chickies, Pa., 240 horse-power; Randleman M'f'g Co., Randleman, N. C., 51 horse-power; D. R. Campbell, Sangerville, Me., 122 horse-power; Interstate Consolidated Rapid Transit Railway Co., Kansas City, Mo., 400 horse-power; Peoples' Cable Railway, Kansas City, Mo., 600 horse-power; Troy Iron & Steel Co., Troy, N. Y., second order, 460 horse-power; Market St. Cable Railway, San Francisco., second order, 500 horse-power; T. A. Edison, (for new laboratory), Orange, N. J., 219 horse-power; New York Steam Co., New York City, sixteenth order, 250 horse-power, making a total of 13,387 horse-power.

Architects, Builders, and others will confer a favor on the Publishers by mentioning "The American Architect and Building News" when sending for circulars or corresponding with parties advertising in these columns

THE IMPROVED FLORIDA STEAM HEATER



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Self-Feeding, automatic, Portable and saves all expense of Brick Work. Most economical. Carries steam from 10 to 13 hours without attention. Compact. 14 sizes, from 4 to 6 feet high. Anti-clinker grate, easily shaken, no dust. Sales larger than the combined sales of all reputable Steam Heaters.

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The best and most reliable White-Lead made, And unequaled for Uniform Whiteness, Fineness, and Body.

ADDRESS, Atlantic W. Lead & Lin. Oil Co. 287 Pearl St., NEW YORK.

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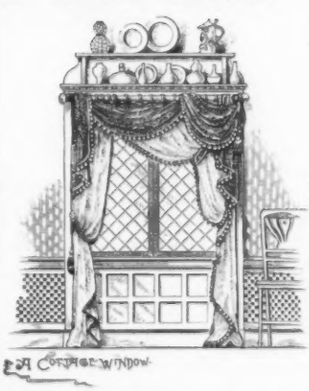

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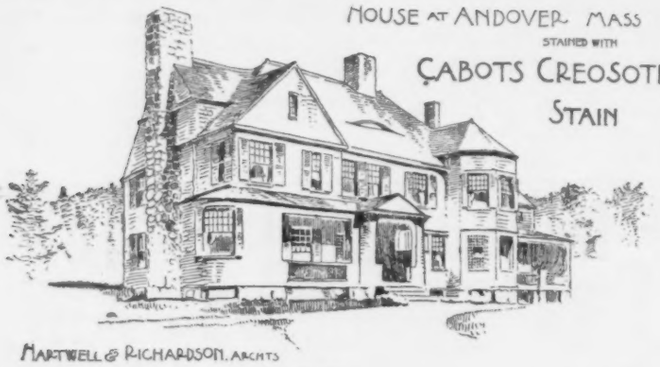

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SAMUEL CABOT, - - - - 70 Kilby St., Boston.

Fine Polished Brass Thumb-latch.

No. 685.
This cut is one-third size.

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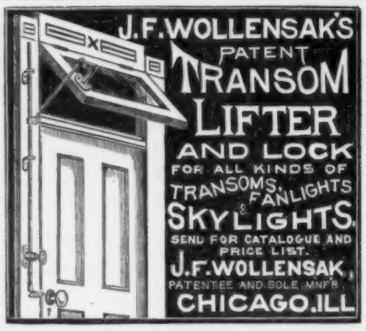

ESTERBROOK'S STEEL PENS

FOR SALE BY ALL STATIONERS.
THE ESTERBROOK STEEL PEN CO.
20 John Street, New York, N. Y.

To Architects and Builders.

Adopt MAHOGANY for interior finish; it is the handsomest and most durable cabinet wood known, and we are prepared to furnish it at prices that compare very favorably with those ruling for other hard-woods.

Correspondence solicited.

Wm. E. UPTEGROVE & BRO., Foot E. 10th & 11th Sts., NEW YORK.